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Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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PROCEEDINGS OF THE SOCIETY.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1905.

TRANSACTIONS OF THE SOCIETY.

I.—*The Theory of Highly Magnified Images.*

On the Diffraction of an Object-Glass with Circular Aperture. By Sir George B. Airy. Philosophical Transactions, vol. v. p. 283.

The Theoretical Limits of the Resolving-Power of the Microscope. By Professor Helmholtz. Poggendorff's Annalen, 1874, *Jubelband, p.* 569; *Wissenschaftliche Abhandlungen, vol. ii. p.* 185.

On the Theory of Optical Images, with special reference to the Microscope. By Lord Rayleigh. Philosophical Magazine, 5*th series, vol. xlii. p.* 167; *Journ. R.M.S.,* 1903, *p.* 447.

On the Theory of Optical Images, with special reference to the Microscope. Supplementary paper. By Lord Rayleigh. Journ. R.M.S., 1903, *p.* 474.

BY J. W. GORDON.

(*Read December* 21*st*, 1904.)

Synopsis.—For the convenience of readers who may like to have the theory of high magnification in a very compendious form, the following synopsis of this paper is submitted:

I. The image formed by any aperture of a luminous point is an illuminated area, the shape and dimensions of which depend upon the form and size of the aperture (Airy, p. 5).

II. The focussed image of such a point is an antipoint, the shape of which is derived from the shape of the aperture by a rule of inverse resemblance, so that the antipoint is narrow across any diameter across which the aperture is broad, and *vice versâ.* This rule of inversion results, in the case of a symmetrical aperture, in an approximate reproduction by the disc of the antipoint of the form of the aperture turned through an angle of 90° (Airy, p. 5).

III. In the case of a circular aperture, transmitting a beam in which the light arrives at the aperture in the form of plane wave-

fronts, the form of the antipoint is a circular disc surrounded by rings, the disc having a radius estimated by Sir George Airy at $\frac{1 \cdot 2\,\lambda}{2 \sin u}$ (Airy, p. 5).

IV. In the case of a circular antipoint the light amplitudes vary in successive zones according to a numerical law illustrated by fig. 2, on p. 6 (Airy, p. 6).

V. The law of diffraction from spherical wave-fronts is such that, if F be the radius of curvature of the wave-front where it passes the aperture, and θ be the angle to the axis of collimation of the axis along which a beam of parallel light passing the same aperture would be diffracted, the diffracted cone will come to focus in the focal plane at a point distant by $\sin \theta . F$ from the axis of collimation (Helmholtz, p. 10).

VI. The dimensions of the antipoint depend only upon the divergence angle of the focussed beam, and are in no way determined by the magnitude of the aperture causing diffraction (Helmholtz, p. 11).

VII. If any optical system yields a correct—that is to say, a flat and aplanatic—image of a plane object, the law of magnification in that system will be that the conjugate images will be proportioned to one another inversely in the ratio of the sines of the divergence angles of the beams by which they are severally formed. Thus the law of relative magnitudes is the same for conjugate images as for conjugate antipoints (Helmholtz, p. 12), and, therefore,

VIII. The state of resolution of a correct image cannot be either improved or impaired by mere change of scale brought about by eye-piece magnification or otherwise, but depends only upon the angle under which incident light is received from the object (Helmholtz, p. 12).

IX. If two beams of light, although originating in independent light sources, follow very closely adjacent and nearly parallel paths, so that they interpenetrate one another, they will modify one another where they interpenetrate, and may thereby become attuned to one another almost as if they had had a common origin, and so as to be capable of exhibiting all the phenomena of interference (Rayleigh, p. 16).

X. The limit of resolving power is not simply a question of the propinquity of luminous objects, but depends in a material degree upon the phase relations of the light by which they are severally rendered visible (Rayleigh, p. 17).

XI. A dark bar on a bright field may theoretically be visible as a boundary between adjacent luminous areas if it has a breadth of $\frac{1}{16}\lambda$ and, under favourable conditions of illumination, even if its breadth be less than this (Rayleigh, p. 18).

XII. Is the antipoint itself polyphasal? The black and white phenomena discussed in the light of this hypothesis (p. 19).

The theory of the formation of the image in a Microscope as at present developed is to be found, so far as I am aware, in the papers above enumerated. Having regard to the great interest and importance of the subject, one must consider this a singularly meagre list, and it is, no doubt, incomplete, since I have depended exclusively on my own reading, which is but fragmentary. I shall no doubt be asked why I have omitted to notice the many papers which have been written in recent years upon the so-called Abbe theory. The answer to that question is very simple, but I must preface it by protesting once more against the use in this connection of Professor Abbe's name. Something of discourtesy is involved in thus making a distinguished man responsible for an hypothesis which he never fully formulated, and has of late explicitly disavowed. Lord Rayleigh has proposed the name "spectrum theory" (Journ. R.M.S., 1903, p. 450) for one of its many forms, but this term has not in fact become current, and if it had it could hardly express the whole confused body of mutually incompatible speculations which go under the name of the Abbe theory. For this is a case in which *quot homines tot sententiæ.* It seems impracticable therefore to break away from the accepted nomenclature, and I employ it under protest and with a sincere apology to Professor Abbe whose name is thus misused.

Mention has just been made of the confused variety of theories which go by this generic name. But they all have one point in common. That is to say, they all set out to explain the image of the object seen in the view plane of the instrument by the image of something else seen in another plane, usually by the image of the source of light seen wherever its image may happen to fall in the tube of the instrument, or by the image of a theoretical source of light seen in the principal focal plane of the objective. Now quite apart from the obvious criticism that this image of the source of light itself stands in need of explanation and of the same explanation as that which the image in the view plane demands, there is another and even more fatal objection to any theory which proceeds upon these lines. For the calculations necessary to connect these two disconjugate images one with the other cannot be made, the reason being that the conditions of aplanatism in the one plane imply a want of aplanatism in the other plane. Thus, if we assume an objective to be so corrected as to yield a flat and aplanatic image in the view plane of a flat object on the stage, that assumption implies two things about the lengths of the optical paths: (1) that all paths from the aperture to a given point in the image are equal, the aperture being, for this purpose, taken to coincide with a plane wave-front, coming to focus in that point; and (2) that all points in the object are equidistant optically from their conjugate points in the image. The first of these follows immediately from the well-known theorem concerning the equality of optical paths between

a point and its image. The second is a corollary, easily deducible from the first, which establishes the equality of all optical paths between a flat object and its flat image formed according to the sine law.*

Both may be comprised in the one proposition, namely, that in a fully corrected system all paths between the aperture and the focal plane are equal. Now it is obvious that this proposition cannot be true for two disconjugate focal planes. The following diagram will make this clear. Here let S_1 S_2 S_3 be the aperture, and let P_1 P_2 be central points in two disconjugate focal planes. Then if the system be aplanatic for the point P_2, all optical distances between the aperture $S_1..S_3$ and the point P_2 will be equal to one another.

In like manner, if we assume that the system is aplanatic also

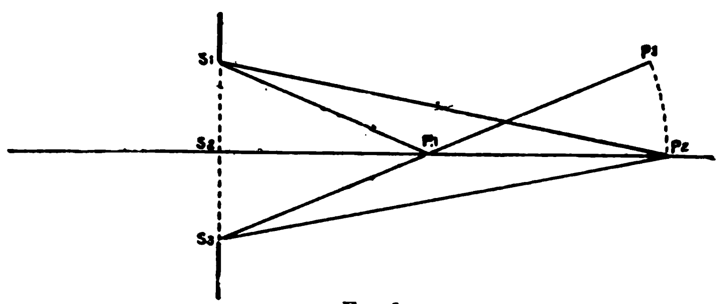

FIG. 1.

for the point P_1, we shall have all paths between the aperture $S_1..S_3$ and the point P_1 equal to one another, and therefore the path $S_3..P_1$ is optically equal to the path $S_2..P_1$. Let $S_3..P_1$ be extended to P_3 and make $P_1..P_3 = P_1..P_2$. Wherefore the path $S_3...P_3 =$ the path $S_2...P_2$, and therefore P_3 is a point in the image formed by the aperture $S_1..S_3$ of a plane surface conjugate to the surface in which P_2 and P_3 lie. But by construction this last-named surface is not a plane but a sphere having its centre at P_1, and the optical system occupying the aperture $S_1..S_3$ is not corrected to give a flat image in this region. If we make the necessary correction to yield a flat field it is clear that we shall incidentally render the point P_1 non-aplanatic, and it follows therefore that no optical system can be fully corrected so as to be

* This second proposition does not appear to be so generally understood as the first. A regular proof of it is given in a note—Note I.—in the appendix to a paper on the Helmholtz Theory of the Microscope, which I had the honour of laying before the Society in 1903 (Journ. R.M.S., 1903, p. 426).

aplanatic and yield a flat image in two planes not conjugate to one another. Now it is manifestly impossible to compute the light phase in a region where the optical system is non-aplanatic, for in that case the phase is wholly indeterminate, and hence it is impossible to make the image formation in the plane through P_2 dependent upon that in the plane through P_1, or *vice versâ*.

Coming now to what has been accomplished in the way of constructing a theory of the image formed by a Microscope, the fundamental proposition is worked out in Sir Geo. Airy's paper, and may be formulated thus :—

I. The image formed by any aperture of a luminous point is an illuminated area, the shape and dimensions of which depend upon the form and size of the aperture.

II. The focussed image of such a point is an antipoint, the shape of which is derived from the shape of the aperture by a rule of inverse resemblance, so that the antipoint is narrow across any diameter across which the aperture is broad, and *vice versâ*. This rule of inversion results, in the case of a symmetrical aperture, in an approximate reproduction by the disc of the antipoint of the form of the aperture turned through an angle of 90°.

III. In the case of a circular aperture, transmitting a beam in which the light arrives at the aperture in the form of plane wave-fronts, the form of the antipoint is a circular disc surrounded by rings, the disc having a radius of $\frac{1 \cdot 2\,\lambda}{2 \sin u}$, and the dark rings surrounding it being situated at radial distances which tend to become equal to $\frac{n\,\lambda}{2 \sin u}$ for the *nth* dark ring. In these expressions λ = the wave-length, u = the divergence angle of the focussed beam, and n is any integer. The inner rings have, as here shown in the case of the first ring, a somewhat greater radius than $\frac{n\,\lambda}{2 \sin u}$.*

IV. Sir Geo. Airy calculates and gives in the form of a table the comparative amplitudes of the light undulation at selected zones in the circular antipoint. Plotted down, his amplitudes are proportional to the ordinates of the curve in fig. 2, where the calculated results are shown by the points of intersection of the curve with the scale rulings. The intermediate values are determined graphically by carrying a continuous curve through the calculated points.

This curve, and the table given by Sir Geo. Airy in the paper cited, are open to the criticism that they express only the semi-

* This is the accepted description of the antipoint formed by a circular aperture, and is given here upon the authority of Sir Geo. Airy. The present writer submits considerations bearing upon it in a note subjoined to this paper (below, p. 25).

amplitude, and consequently show negative values for the calculated amplitude in certain parts of the light curve. For the mere determination of relative magnitudes this is unimportant, since semi-amplitudes must have the same proportions *inter se* that the corresponding amplitudes have. But when we go further and ask what is the resulting amplitude if two adjacent and isophasal antipoints encroach the one upon the other, it then becomes important to realise that the negative values in Airy's curve do not

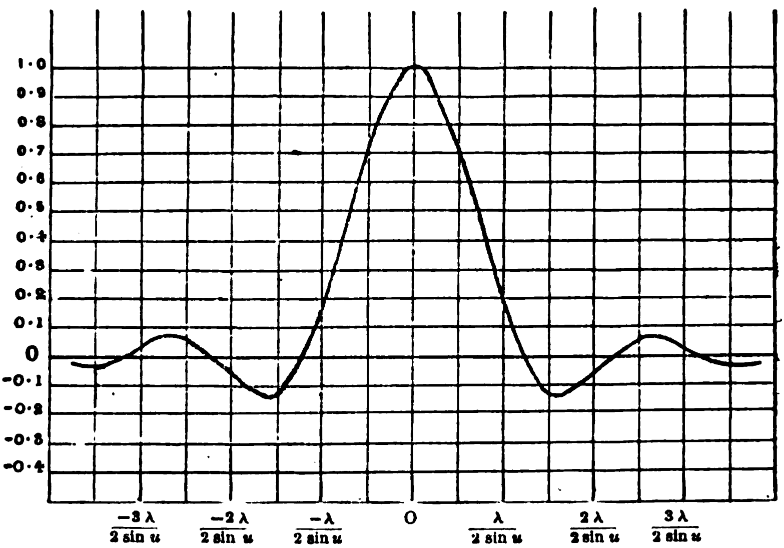

Fig. 2.

count against the positive. The coincident amplitudes have then to be compounded according to the relative retardation of the one as compared with the other; whether expressed as positive or negative quantities on Airy's curve makes no difference for this purpose. The following diagram will make this clear. Here, in fig. 3, we have the full amplitude curve of the "false disc," and it will be observed that at every point it has a positive and a negative half, each equal in point of mere magnitude to the other. Hence the full ordinate is in this curve proportional at every point to Airy's ordinate, but on the other hand no one has either a positive or a negative value, and any two may be compounded indifferently either by addition or by subtraction. This corresponds to nature, for, in fact, two ordinates are to be compounded by addition when they have a phase difference of $n\ \lambda$, n being any integer, and are to be compounded by sub-

traction of the lesser from the greater when they have a phase difference of $\frac{2n-1}{2}\lambda$. The general expression of which these two are particular examples, and by which any two amplitudes A_1 and A_2 having a phase difference $\frac{\phi . 2\pi}{\lambda}$ may be compounded is:

$$A_{(1+2)} = A_1 + \cos \frac{\phi}{\lambda} 2\pi A_2 \quad . \quad . \quad . \quad . \quad (1)$$

or, more generally still, if we assume that both the components A_1

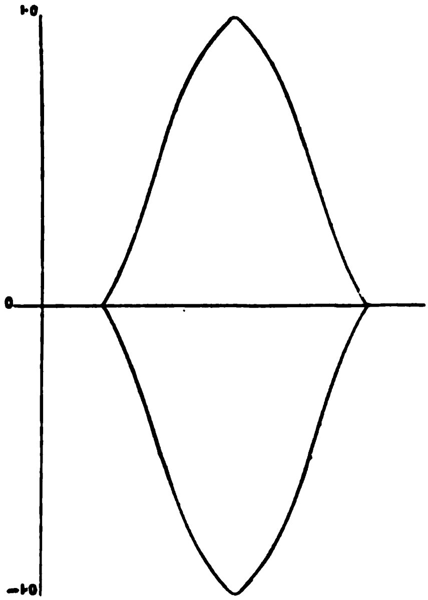

FIG. 3.

and A_2 are affected with retardation relatively to the phase of the resulting disturbance, we may write these retardations $\frac{\phi_1}{\lambda} 2\pi$ and $\frac{\phi_2}{\lambda} 2\pi$ respectively. Then the two amplitudes in question may be compounded thus

$$A_{(1+2)} = \left\{ A_1 \cos \frac{\phi_1}{\lambda} 2\pi + A_2 \cos \frac{\phi_2}{\lambda} 2\pi \right\} \quad . \quad . \quad (2)$$

Sir Geo. Airy's table contains the constants A_1, A_2, etc., required in this equation, and clearly its calculated value would be largely

affected if certain of the constants employed were affected with a negative sign and others not. For this purpose, therefore, the emendation of Sir George Airy's table is of importance.*

Of the antipoint formed by a star in the image plane of a telescope, Sir Geo. Airy's theory affords a sufficient explanation, subject only to very small corrections, and that, in truth, is all that its author set himself to explain. But as it stands in the 'Philosophical Transactions,' the theory is not directly applicable to the image formed by a Microscope, and this for two reasons:

1. The Microscope receives upon its objective not plane but spherical wave-fronts of incident light; and

2. The object on the stage of the Microscope, even when very minute, is not infinitesimally small, like the disc of a star seen in the heavens, but is always of finite dimensions and usually of sensible magnitude.

In order to adapt the Airy theory to the case of the Microscope, both these new conditions must be investigated—that is to say, the law of diffraction from spherical wave-fronts must be ascertained and substituted for the law of diffraction from plane wave-fronts as the basis of the theory, and the diffraction fringe formed about a small finite area must be substituted for the antipoint curve as the boundary region between light and dark areas.

So the problem stood when, in 1874, Prof. Helmholtz contributed his paper to 'Poggendorff's Annalen.' The paper was a composite, put together confessedly under great pressure of time and apparently comprising, to judge by internal evidence, three constituent fragments tumbled together without sufficient or effectual editing. It is proper to recall these circumstances when discussing Helmholtz' paper, for they explain its limitations; they explain, for example, how it should have come about that Prof. Helmholtz, while he solved the first half of the problem, and showed how to adapt Airy's theory to an instrument receiving spherical wave-fronts, left the second half unattacked, and incautiously assumed that the diffraction fringe of the smallest visible luminous area would be indistinguishable from the section of an antipoint. Such shortcomings are the results of precipitation, which betrayed even the great Helmholtz into serious error.

But it is his solution of the first part of the problem which concerns us, and this is so elegant that, formidable as the problem itself looks, the solution can be stated in a few words if we confine ourselves to results, referring the reader to other sources of information for the demonstration.

* There is another point affecting the form of the curve discussed in Note I. (below, p. 30 (*b*)), in respect of which it may turn out that Sir Geo. Airy's results require correction.

Let ϵ in fig. 4 be a point on the stage of a Microscope. Let P be the principal plane of the objective. Let A be an aperture which limits the diameter of the transmitted beam, and let η be the point in the image plane conjugate to ϵ.

The question is to find an expression for the diameter of any given zone in the antipoint formed about η by the aperture A.

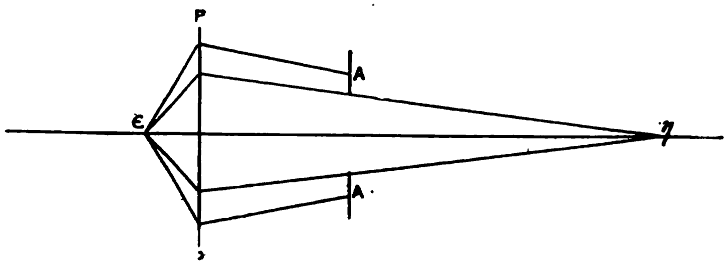

FIG. 4.

Helmholtz' solution of the problem may be stated thus:

Let A in the following diagram (fig. 5) be the given aperture, having rectilinear boundaries; $a..\ a$, the axis of collimation, and η the point upon that axis to which the transmitted wave-front converges.

Also let $a_1 \ldots a_1$, intersecting the axis $a \ldots a$ at an angle θ, be the axis along which the diffracted beam in question would be

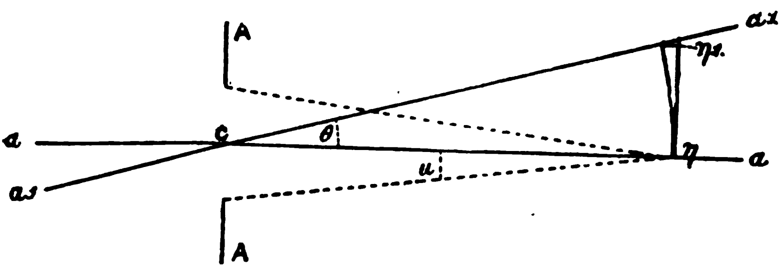

FIG. 5.

deflected if the wave-fronts passing the aperture were not spherical but plane wave-fronts. Then, by the known law of diffraction, $\sin\theta = \frac{\phi}{A}$, the symbol ϕ being used to express in terms of λ the retardation of the most retarded ray in the diffracted beam. Now it is plain that the axis $a_1 \ldots a_1$ will intersect the perpendicular plane through η—which may be called the focal plane—at a point η_1 so situated that its axial distance

$$\eta \ldots \eta_1 = \tan\theta\,(c \ldots \eta) \quad . \quad . \quad . \quad . \quad (3)$$

In like manner the aperture A may be expressed in terms of the divergence angle u thus

$$A = 2 \tan u \, (c \ldots \eta) \quad . \quad . \quad . \quad . \quad (4)$$

and dividing (3) by (4) we obtain for a parallel beam of light the following equation between the diameter of the aperture and the diameter of the unfocussed antipoint—

$$\frac{\eta \ldots \eta_1}{A} = \frac{\tan \theta}{2 \tan u} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

V. Helmholtz deduces for the case of the spherical wave-front focussed upon η a law from which it may be inferred that in that case the expression (5) becomes

$$\frac{\rho}{A} = \frac{\sin \theta}{2 \sin u} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where ρ is written for the radius of the antipoint, or rather of that zone in the antipoint which is formed by the focussing of those diffracted beams which have the retardation $= \phi$, and is, therefore, a general expression for $(\eta \ldots \eta_1)$.

This last expression can be further simplified. For in the case of an aperture with straight parallel edges, the value of θ in a plane perpendicular to the edge is known to be, as above stated, such that

$$\sin \theta = \frac{\phi}{A},$$

whence

$$\rho = \frac{\phi}{2 \sin u}, \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

and this in the case of a circular aperture becomes

$$\rho = 1 \cdot 2 \, \frac{\phi}{2 \sin u} \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)^*$$

When ρ is the radius of what is commonly called the false disc the phase value ϕ is equal to one complete cycle of phase change, and may therefore be expressed by one wave length. Thus we obtain the well-known expressions

$$\rho = \frac{\lambda}{2 \sin u} \text{ or } \rho = 1 \cdot 2 \, \frac{\lambda}{2 \sin u},$$

according as the aperture is limited by a rectilinear or by a circular boundary.

* The expression $\frac{1 \cdot 2 \, \lambda}{2 \sin u}$ is very approximately correct, if we adopt Sir Geo. Airy's equation for the antipoint light curve, for the inner zones (say those within the boundary of the false disc) of the circular antipoint—with which alone we shall be concerned in the present paper. In the outer zones the circular antipoint tends to conform to the dimensions of the rectilinear antipoint, that is to say, $\rho = \frac{\lambda}{2 \sin u}$.

From this result several very important inferences may be drawn. Thus, since the expression $\frac{\lambda}{2 \sin u}$ is independent of the dimensions of the aperture, we may infer that—

VI. The dimensions of the antipoint depend only upon the divergence angle of the focussed beam, and are in no way determined by the magnitude of the aperture causing diffraction. This sounds surprising, for we know that the sine of the diffraction angle is inversely proportional to the diameter of the aperture, and are apt to assume that the dimensions of the antipoint will vary in a similar fashion. But a little reflection suggests that the divergence angle must have more to do with the diameter of the antipoint than has the breadth of the aperture, for, the divergence angle remaining unchanged, the distance of the aperture must be proportional to its diameter. Fig. 6 illustrates this relation.

Here, whether we take the aperture to be A_1, A_2 or A_3, it is

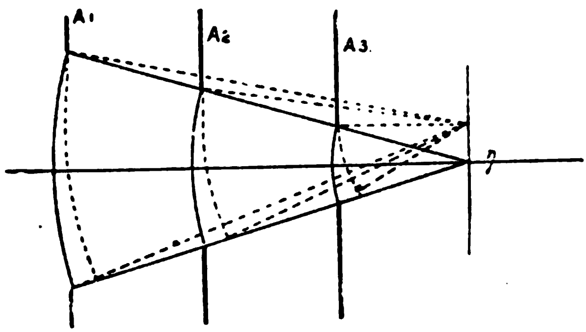

Fig. 6.

plain that the sine of the diffraction angle multiplied by the distance of the aperture from the point η will be a constant quantity $= \frac{\phi}{2 \sin u}$; in other words, the antipoint will be unchanged whatever change may take place in the length of the beam, provided that its divergence angle remains unchanged.

From this principle Helmholtz deduces a very elegant result. Since the antipoint depends only upon the divergence angle of the focussed beam, it can make no difference to it, and no difference therefore to the state of resolution of the image at what point in the system the diaphragm is placed, by which the beam is defined and diffraction caused. Therefore the actual dimensions of the antipoint will be determined by that aperture which has the smallest optical projection upon the principal plane of the entire optical system. Furthermore, it is clear that there can only be one such aperture, and therefore, whether we consider the beam to be transmitted upward towards the ocular and out through the eye-

lens, or downwards towards the objective and out through the front lens, in either case we shall have to deal with the same limiting aperture, and both the actual antipoint in the real image and the theoretical antipoint produced in the object by the reverted beam will depend simply on the divergence angles in the front and back of the instrument respectively.

We thus see that a simple numerical relation can be established between conjugate antipoints, but for the full significance of this proposition we must consider it in the light of another, which also we owe to Helmholtz and find in this paper, and which connects conjugate images by the same law. For Helmholtz shows that if any optical system—no matter how simple or how complicated —yields a correct (i.e. a flat and aplanatic) image of a plane object, the law of magnification in that system will be—

VII. The conjugate images will be proportioned to one another inversely in the ratio of the sines of the divergence angles of the

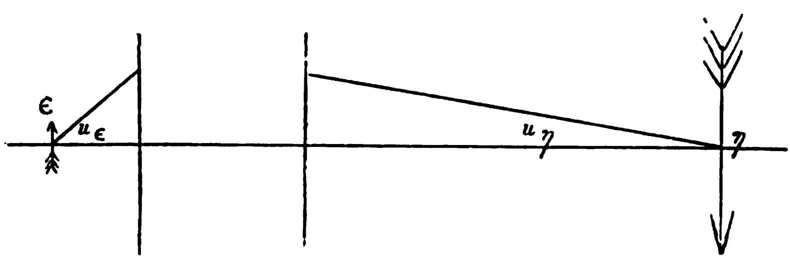

Fig. 7.

beams by which they are severally formed. Diagrammatically, if in fig. 7 ϵ be an object (or an image) and η its conjugate image

$$m = \frac{\eta}{\epsilon} = \frac{\sin u_\epsilon}{\sin u_\eta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

It is evident that a similar rule with regard to antipoints can be deduced from equation (8). For putting ρ_ϵ and ρ_η for the diameters of the conjugate antipoints, we have

$$\rho_\epsilon = 1 \cdot 2 \frac{\phi}{2 \sin u_\epsilon} \text{ and } \rho_\eta = 1 \cdot 2 \frac{\phi}{2 \sin u_\eta}$$

$$\therefore \frac{\rho_\eta}{\rho_\epsilon} = \frac{\sin u_\epsilon}{\sin u_\eta} = m \text{ by equation (9)}$$

From this proposition several important conclusions can at once be drawn.

In the first place we perceive that—

VIII. The state of resolution of a correct image cannot be either improved or impaired by mere change of scale, whether effected by eye-piece magnification or otherwise. If you magnify the image you magnify the antipoint in the same proportion, and

therefore there is no improved delineation of detail. If you diminish the scale of the image you diminish the scale of the antipoint in the like ratio, and the details are therefore as sharply defined in the small scale picture as in the large. One scale may be more conveniently visible than the other, but intrinsically the picture remains throughout all changes of scale self-identical. This is the first great practical conclusion which Helmholtz has established, and not for the Microscope alone but for all optical instruments which have aplanatic foci and flat fields.

But it may be asked why then do not all Microscopes, equally well corrected for spherical and chromatic aberrations, give equally perfect images? If scale has nothing to do with resolution, why should an objective of wide angle possess higher resolving power than a low powered objective?

The answer to that question is really very simple, but is not easy to be expressed. Perhaps the clearest way to state it is to postulate that the object *seen* by the aid of any optical instrument is not in strict truth the thing itself, but a simulacrum of the thing itself produced by the instrument.* If this seems to be an artificial view of the case let it be considered that this is manifestly so when the optical instrument is a coloured medium—say a piece of ruby glass. We know that in such a case the object seen is a profoundly modified presentment of the object as it exists. Less obviously, but quite as truly, the appearance of an object seen through an aperture is profoundly modified by the diffraction to which the aperture gives rise. Every point upon the object is thereby converted into an antipoint for presentation to the eye, and so in place of the object as it *is*, delineated, as we may say, by points of light varying infinitely in colour and intensity, we have the object reproduced by means of antipoints, which not only vary in colour and intensity, but which also encroach upon one another, and so blur and complicate the whole result by their reciprocal interaction.

We are now in a position to answer the question, why does a beam of wide angle yield a better image than that yielded by a narrow angled beam? The beam of light received by the aperture of the instrument from any point upon the object may under this point of view be regarded as an instrument—a pencil, say—by which the supposed point is depicted in the optical field. If, now, this pencil reproduces a point by a coarse antipoint, it will obviously delineate a less perfect representation of the original than if it uses a fine antipoint for that purpose. Now as the diameter of the antipoint is inversely proportional to the sine of the divergence-angle —$1/\sin u$—it is clear that the beam having the larger angle will, *cæteris paribus*, yield the more exact picture. The difference is

* This idea has been much insisted upon by Dr. Johnstone Stoney in several papers on the theory of the Microscope. See the Phil. Mag., 5th ser., vol. xlii., p. 426, *et seq*

precisely like the difference between drawing an object with a fine-pointed pencil and with a stick of charcoal. The finer antipoint will obviously yield the better resolved picture.

This way of viewing the matter led Helmholtz to enter upon some very interesting speculations concerning the ultimate limit of resolving power. For it is evident that the expression $\frac{1 \cdot 2\,\lambda}{\sin u}$, which expresses the diameter of the false disc of an antipoint produced by a circular aperture, cannot be infinitesimally small. The value of the wave-length λ will be somewhere in the region of $\frac{1}{50000}$ inch, and $\sin u$ cannot be greater than 1. If then we write $2\,\rho = 1 \cdot 2\,\lambda = \frac{1 \cdot 2}{50,000}$ inch, we shall have the smallest antipoint that can by any possibility be obtained with green light of the wave-length mentioned. What, then, must be the minimum separation of two bright objects which are by means of such an antipoint to be separately delineated? This is the much discussed and profoundly interesting problem of the limit of resolving power.

Professor Helmholtz, although he approached this problem, as we have seen, by a series of most masterly attacks upon what may be called its outworks, did not drive his attack home or succeed in capturing the citadel itself. It is not difficult to realise what remained to be done. The form, dimensions and illumination of the antipoint being taken to be known, it becomes in the next place necessary to consider how the overlapping of adjacent antipoints will affect the appearance of the field in which they lie. This, clearly, is a problem of great complexity, for antipoints may overlap in all imaginable degrees, from complete coincidence, as one extreme case, to complete separation as the opposite extreme. Moreover, any number of antipoints may overlap, and with varying degrees of encroachment upon the common area, thus giving rise to still further complexity. Helmholtz did not essay the regular solution of this problem; it appears, indeed, from a postscript appended to his paper, that the necessary time was not at his command. But he thought that the extreme case could be very simply stated, and in effect he stated it as follows. Let A_1 A_2 in the following diagram (fig. 8) be two adjacent antipoints which encroach upon one another. What is the smallest distance between their centres at which they can be discerned as separate objects? The figure shows pairs of antipoints. The members of the first pair may be assumed to be indistinguishably merged in one another. The members of the third pair may be taken to be unmistakably distinct. If we assume the second pair to be at the limit of resolving-power, what will be the calculated distance of their centre points from one another? This would be the exact statement of the problem of the resolving limit as Helmholtz conceived it. But putting aside

refinements, he selects a case well, as he supposed, within that limit, and propounds it thus. Taking a median section of the paired

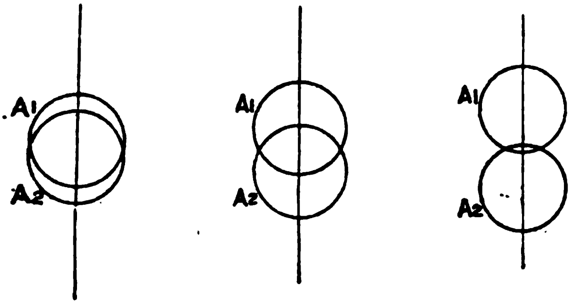

Fig. 8.

antipoints, as shown by the section lines in the figure, he first draws their light intensity curves calculated by Sir George Airy's formula, next he adds together the ordinates of the overlapping parts of the curves, and so obtains the total light intensity curves shown by broken lines in fig. 9.* When the distance between

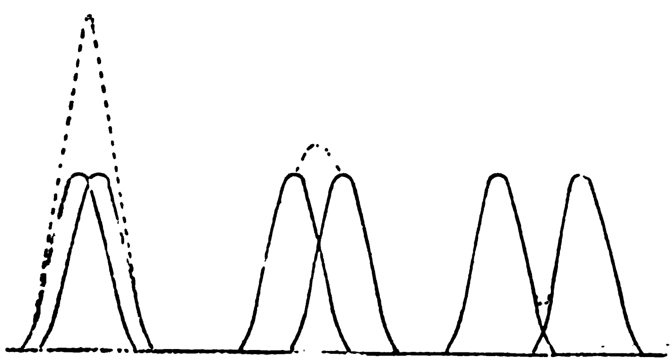

Fig. 9.

the two centres = ρ or $< \rho$, the total curve will show, as in the first and second pairs of the figure, no more than one maximum, whereas the widely separated members of the third group will yield two maxima as shown. Hence Helmholtz concluded that a centre to centre distance = ρ would be too small for the representation of the two adjacent points as separate objects. This rule would of course give a limit of $c = \frac{1 \cdot 2\, \lambda}{2 \sin u}$ in the case of a circular aperture if we write c for the centre to centre distance now under discussion,

* The curves shown are actually reduced copies of Airy's *Amplitude* curve. The resulting inaccuracy is not conspicuous, and will not, it is hoped, occasion the reader any difficulty.

but Helmholtz, not putting this forward as an exact solution, did not in fact state it with so much precision. He was content to say, using a merely approximative figure, the limit of resolving power must necessarily be $> c = \frac{\lambda}{2 \sin u}$. This is the well-known limit which on his authority and that of Prof. Abbe has been adopted by almost all subsequent writers upon the Microscope as the ultimate and necessary limit beyond which its performance can never go. It is a curious circumstance that both Helmholtz and Abbe should have fixed upon this expression. It is not, as has just been shown, the true result of Helmholtz' theory, but a figure arbitrarily selected as lying within the true limit, and Abbe was led to it by considering the rather fanciful question as to how a picture could be formed of an object illuminated by a beam of light having a divergence angle $= 0$. It is a mere coincidence, but a very strange one, that two such widely different attempts to solve the problem should both lead to the same result, and that an erroneous result. It is perhaps less surprising that the error so authenticated should have passed undetected and even unchallenged until 1896.

In the last-named year Lord Rayleigh published a paper in which the whole subject was reviewed, the inadequacy of Prof. Abbe's treatment of it was pointed out, and a very pertinent inquiry started as to whether Helmholtz' method of obtaining the values of his total light curves (see fig. 9 above) took due account of the phase relations of contiguous antipoints. So long as we concern ourselves only with light intensities (ignoring the light amplitudes) no question of phase relation and resulting interference can arise; and it is commonly assumed by physicists that unless two beams of light originate in the same incandescent particle they must be independent as to phase, and cannot, therefore, exhibit the phenomena of regular interference. This is only very imperfectly true, and Lord Rayleigh in this paper showed that—

IX. If two beams of light, although originating in independent sources of light, follow very closely adjacent and nearly parallel paths, so that they interpenetrate one another, they will modify one another where they interpenetrate, and may thereby become attuned to one another almost as if they had had a common origin, and so as to be capable of exhibiting all the phenomena of interference.* It now appears that the results of overlapping must be more complex than Helmholtz had assumed, and Lord Rayleigh illustrates this fact by taking three typical cases. He assumes (1) that the over-

* This interference of light beams from independent sources would seem to have been illustrated by a very elegant experiment devised by Dr. Johnstone Stoney, and demonstrated by him at a Meeting of the British Association. See Rep. B.A., 1901, p. 574.

lapping antipoints are attuned and to the same phase; (2) that they are attuned, but with a phase difference $\Delta \phi = \frac{\lambda}{2}$; and (3) that they are independent as to phase. The result of considering case (2) is very remarkable, for it then appears that, however close the centres may be, the antipoints will be seen, if at all, as separate objects. If they were to coincide exactly it is obvious that the light of the one would quench that of the other, and if they were separately of equal brightness the one to the other they would become invisible. In any case, if the centres be separated by a distance, how small soever, the middle point between those centres must be a point of darkness and, therefore, a dark boundary must separate the two illuminated areas. Here then we have an unlimited resolving power. It thus appears that—

X. The limit of resolving power is not simply a question of the propinquity of luminous objects, but depends in a material degree upon the phase relations of the light by which they are severally rendered visible, and from this it follows as a practical inference that the expedient of controlling the phase relations of adjacent antipoints—if we can find the means of applying it—will give us command of a resolving power beyond the Helmholtz limit, and possibly beyond any limit that can be assigned. To this point we shall have occasion to recur upon a later page in this paper.

There is still another point in respect of which Helmholtz' result invites criticism. As already stated, the limit which he named was not put forward as an exact or calculated limit, but as a result of which actual practice must always and necessarily fall short, and fall short by a considerable measure. He took the antipoint as the extreme case of a very small surface, and argued that if two antipoints could not be separated from one another, the two finite surfaces on the confines of which these antipoints lay must in like manner be inextricably fused together. There is here a very singular oversight, the nature of which may be exhibited by a diagram. In fig. 9 (*ante*, p. 15) any one of the six curves shown represents the light amplitude curve of an antipoint, but that of a luminous area in which antipoints stand side by side and close to one another, overlapping as completely as may be, will be represented by the curve of the following figure (fig. 10). It is clear that the full brightness of the luminous area is not developed at its very edge, but at a distance $= \frac{\lambda}{2 \sin u}$ measured inward from the edge. Moreover, the light intensity here, even if the antipoints have no determinate phase relation *inter se*, will be double the intensity at the true focus of a single antipoint, and if, therefore, we

have in place of the two antipoints postulated by Helmholtz two luminous areas having each a transverse diameter at least $= \frac{\lambda}{\sin u}$, these areas may be clearly distinguishable, even though their adjacent edges are separated by a distance $< \frac{\lambda}{2 \sin u}$.

The problem of resolving power which thus emerges, when the case is considered of two small luminous areas of finite dimensions, having each a diameter of not less than $\frac{\lambda}{\sin u}$ measured away from the bounding edge, engaged the attention of Lord Rayleigh in 1903, and one particular case of it was treated in a paper which he communicated to this Society, being the last of the papers enumerated at the head of this article. Lord Rayleigh assumes two such areas separated by a dark bar, and calculates by the method of his former paper what in that case would be the minimum breadth of such a dark bar, which would visibly separate the field into two luminous areas.

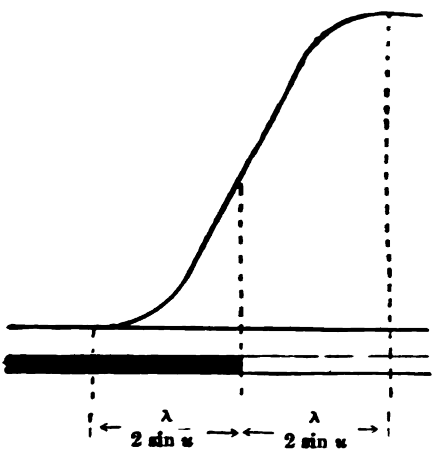

Fig. 10.

XI. The result varies according to the reciprocal phase relation of the adjacent luminous edges. If these have a constant phase difference $\Delta(\phi) = \frac{1}{2}\lambda$ the bar will be a visible boundary, however narrow. But if the phase difference $\Delta(\phi) = 0$, that is to say, if the same wave-front extends beneath the bar and illuminates both the separated areas—the worst case—then the bar must have a minimum breadth $= \frac{1}{16}\lambda$. If, on the other hand, there is no phase relation, and therefore no regular interference, the bar will still be visible, although it has a breadth no greater than $\frac{1}{32}\lambda$. Here, at last, we begin to get into touch with fact. The conditions which Lord Rayleigh stipulates for in this paper are such conditions as may possibly arise in practice. Luminous areas and dark bars of the small but finite dimensions named are objects which the microscopist is actually concerned at times to see, whereas a luminous point—the word "point" being used in a mathematical sense—is a figment of the scientific imagination and a single antipoint is what no man has seen or ever will see.

But Lord Rayleigh's results, although eminently suggestive and stimulating to further investigation of this profoundly interesting subject, are by no means exhaustive. The dark bar is not the essential and ultimate element of the microscopic picture. The black dot is even more familiar and more profoundly important to the microscopist. He would like to know how small it may be and yet remain visible, and he would like to know also how its appearance is modified by the laws of antipoint structure. The investigation of the case of the dark bar has yielded results so striking and so full of promise that he grows naturally impatient to have the case of the black dot similarly examined. The dark bar has only one finite dimension, the black dot two finite dimensions, and therefore it offers a problem of considerably increased complexity for solution. But on the other hand the solution is of higher value in at least an equal measure, for whereas the dark bar is an element in certain pictures only, the black dot is an element in all, and the most significant element of some of the pictures which have the highest significance for microscopists and for humanity.

The problems connected with the black dot constitute thus at the present time the great *terra incognita* of the theory of the Microscope. But exploration in this region, promising as it is of results of the most profound significance and of the greatest practical importance, will certainly miscarry if it proceeds upon a false postulate, and in this connection there is a question concerning the structure of the antipoint which has apparently escaped attention down to the present time, but which must needs be asked and answered as a preliminary to any secure advance.

In all these investigations, thus far discussed, it has been tacitly assumed that the antipoint is itself monophasal. But this has never been proved and it does not stand to reason. It is quite possible that the successive zones of the antipoint differ not only by a gradual change of light intensity but also by a gradual change of phase, and if this be so it will have a most pronounced effect upon the phenomena of overlapping antipoints. The discussion of this question from the theoretical standpoint involves too much detail to be incorporated here, and is therefore relegated to a note.* But the experimental proof may well be noticed in this place.

Let it be assumed, then, that the structure of a given antipoint involves not only a variation of light intensity according to Airy's law but also a gradual change of phase resulting in a retardation equal to $\frac{1}{2}\lambda$ between the centre of the false disc and its boundary. Such an antipoint may be represented diagrammatically by fig. 11, where the false disc of the antipoint is arbitrarily cut up into five concentric zones, and the symbol ϕ by its inclination indicates the corresponding change of phase. It is clear at once that two such

* See Note on p. 25 below.

antipoints, placed so as to overlap one another, would yield total amplitude curves very unlike those which we have been considering, so that all the results so far reached must be considered precarious if this new hypothesis be entertained. There are also certain phenomena highly characteristic of this graduated antipoint of which the monophasal antipoint affords no kind of explanation. To these we may now proceed.

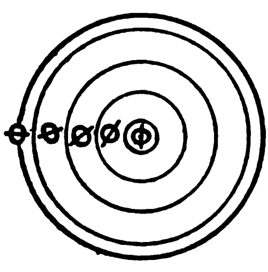

FIG. 11.

It is necessary for this purpose to investigate the law according to which a polyphasal surface such as that of fig. 11 must be propagated, and for this purpose we may provisionally* have recourse to the well-known principle of Huyghens. Let R...R of fig. 12 be such a surface, and let the derived surface $r \ldots r$ be drawn parallel to it and at a distance $= \lambda$ from it. Then the surface $r \ldots r$ will exactly reproduce the surface R...R as shown, the final phase in every ray being equal to the initial phase $+ \lambda$. If we trace another surface, $r_{\frac{1}{2}} \ldots r_{\frac{1}{2}}$, midway between these two, we shall have a third surface in which the phase on any given ray is intermediate between the initial and the final phases. Similarly, if we select a fourth plane, $r_{\frac{1}{4}} \ldots r_{\frac{1}{4}}$, intermediate between the last named and R...R, we

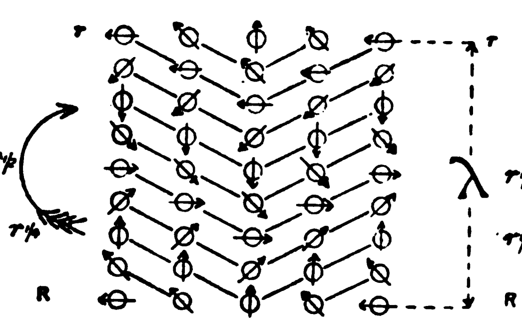

FIG. 12.

shall there find the phase value intermediate between the initial and halfway phases. It will be clear without formal proof that the lines $\phi \ldots \phi \ldots \phi$ of the diagram indicate monophasal surfaces, the existence of which in the position so delineated is implied by the existence in the initial plane of a polyphasal surface, having the postulated graduation of phase values in its various zones.

We thus see that a surface having this structure, itself the

* "Provisionally," because the polyphasal surface cannot be propagated strictly according to Huyghens' law, i.e. not with the velocity of light; but for short distances the assumption is allowable.

result of diffraction from a wave-front, will in its turn give rise by further diffraction to a monophasal surface or true wave-front, a wave-front which, in the case supposed, would have a conical form. It will be interesting to consider what are the phenomena to which such a conical wave-front would give rise.

Let P of fig. 13 be such a conical wave-front, and suppose, first, that the observer's eye is focussed on the plane p, situated a

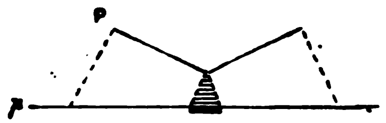

Fig. 13.

Fig. 14.

little below the apex of the cone. It is clear that the conical wave-front, optically projected backward on to the focal plane, will in that case produce a nebulous light in the middle of the field fading off towards the outer edge, where the illuminated zones are largest, and forming a strongly marked boundary at the inner edge, where a dark spot occupies the actual centre of the field. It may be observed that this nebula is, in fact, an expanded antipoint. Fig. 14 is actually drawn from such a nebula with the black dot at its centre.

Next suppose the focal plane to be carried up to the position p_2 shown in fig. 15. The part of the cone above the focal plane will be optically projected down upon it, and the part below will be propagated up to it, with the result that the nebula will

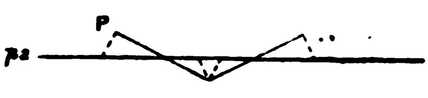

Fig. 15.

Fig. 16.

be diminished in extent, enhanced in brightness, and its centre occupied by a strong point of concentrated light. The black dot has changed into a white dot. Fig. 16 is a drawing of a white dot produced in this way.

Finally, assume the focal plane to be carried up to the position p_3 of fig. 17. Here the nebula becomes still larger, and, being more diffused, weaker towards its outer edge. The inner edge will, however, still be strong. and will clearly mark off a black dot in the centre, so that we have returned, not indeed in the structure of the image, but almost exactly in point of appearance, to the condition of things illustrated by fig. 14.

Very interesting results emerge if we consider what will happen if some part of the conical wave-front be blotted out. For example, we may suppose the apex to be cut off by an opaque

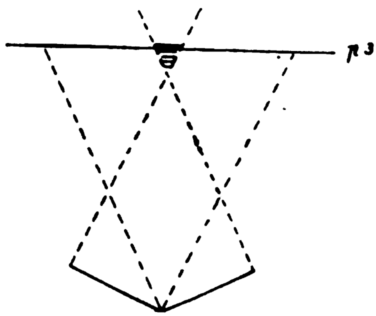

FIG. 17.

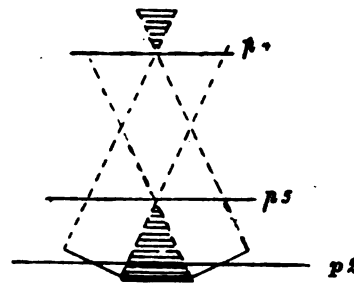

FIG. 18.

object introduced into that part of the field, as in fig. 18. In that case it is plain that we shall not have a bright dot at the level of p_2, but a projection, having reduced diameter, of the opaque object surrounded by a nebula of diminished breadth. This will suddenly change into a bright dot when the plane p_5 is passed, to be again reversed into a black dot as before at the level of p_4.

The microscopist will recognise in these descriptions a close resemblance to certain phenomena very familiar in high power microscopy, where objects come into view having dimensions commensurable with the dimensions of the antipoint, but for practical application the theory must be so extended as to include the common case in which we have to deal with sources of illumination of finite extent and in which the individual antipoint is merged, and the boundaries between light and dark areas are traced by diffraction fringes. The great problem then may be formulated thus: What is the structure of a diffraction fringe if we assume that the antipoint, instead of being monophasal, has the phase structure of fig. 11, in which successive zones exhibit successive phases in a regular series?

The mathematical solution of this problem is too intricate to be developed here, and therefore my own contribution to it is embodied in a note. The result of the note is a rough approximation only to the desired solution. It may even be that the problem is not susceptible of a complete solution, but if it be I must leave the task of solving it to other and abler hands. For immediate purposes the broad result suffices that in a diffraction fringe, as in the antipoint, we have a polyphasal surface which may be divided into zones parallel to the true boundary, and when so divided will exhibit the successive phases in due serial order. A typical diffraction fringe is represented diagrammatically in fig. 19, and it will be observed that the fringe extends for a distance equal to the radius

of the antipoint on each side of the true boundary, and that whereas the light intensity curve shows an uninterrupted progression from edge to edge of the fringe, it is not so with the phase change. On

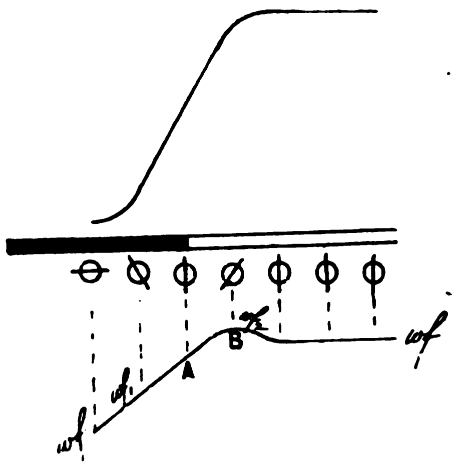

FIG. 19.

the contrary the phase, proceeding by an uninterrupted change, reaches at the point A, which stands vertically over the boundary, its permanent value; then, continuing the change as far as the point B, the phase there attains its highest value, and from that point by a retrogressive change it falls back until at the brighter edge of the fringe it reaches once more the permanent value, which it retains over the rest of the illuminated area. The result is, as shown at *wf* in the figure, a wave-front having a recurved or corrugated form. Thus the two parts wf_1 and wf_2 will be propagated in different directions, one towards the left the other towards the right of the diagram, and we shall have two conical wave-fronts, the one expanding while the other contracts, each in its turn forming a ring about the other—the one giving rise to a broad ring and large bright dot focus, the other to a narrow ring and exquisitely

FIG. 20.

small focal bright dot. Fig. 20 is a drawing depicting these phenomena, and they are this evening demonstrated by means of a suitable telescope and artificial star.

In this connection it is of interest to examine in the light of the foregoing deductions the actual appearance of such a microscopic object as the photograph of *Pleurosigma angulatum*, contributed by Mr. F. E. Ives to the Society's Journal, and appearing at p. 529 of the volume for 1902. In the photograph of a somewhat deeply curved valve the focal plane lies at varying distances above and below the object itself, which is accordingly shown in parts as a black dot picture and in other parts as a white dot picture, and the development of the one picture out of the other can be traced in strict accordance with the theory. The critical test of measurements in depth cannot of course be applied to a mere photograph, but the appearances of the dot in the different parts of the field correspond so strikingly to what has been above described in connection with the theoretical behaviour of a conical wave-front, that even without precise verification these correspondences can hardly fail of receiving the attention of microscopists.

All this is but preliminary to the attack upon the problems of visibility, resolution and interpretation of the black dot in the microscopic image, but those problems are too large to be discussed at the end of a long paper, and, moreover, as they have not been in any way illustrated by my authorities they do not properly fall to be discussed in this place. Only one thing remains to round off the present theme, and that may be dealt with in a few words.

Lord Rayleigh has shown, as is above stated (p. 18), that resolving power can be improved by giving a certain gradation of phase to the illumination of the microscopic field. We now see that the diffraction fringe affords us the means of producing such a gradation of phase, and we may accordingly conclude that if we employ a fringe of suitable breadth for the illumination of the stage we shall obtain better resolution than if it be flooded with focal light. Experiment fully justifies this expectation. The following may be taken as an example.

Take a test object exhibiting features which lie at the limit of the resolving power of the objective, and adjust the instrument so as to secure the best obtainable image of those details. Next, arrange somewhere between the lamp and the condenser a piece of card or other opaque object having a keen edge, so that it can be gradually introduced into the margin of the illuminating beam from the lamp. Now observe the image while the card is so brought slowly and cautiously into the beam. You will see its diffraction fringe steal across the field of the Microscope, and as it does so it will give the most astonishing crispness to the details of the image. Of course such a diffractor introduced from one side of the apparatus is very astigmatic, and tends to produce distorsion by strengthening the shadows which lie parallel to its edge out of proportion to those which lie at right angles to it. But for the purpose of demonstration this is actually an advantage, and for

practical use a more serviceable form of diffractor could easily be devised. Indeed, diffractors which really work upon this principle are already in extensive use in the form of spot-lens apparatus for producing oblique illumination. But the art and science of oblique illumination must be classed among the matters which are at present ill understood for want of a sound and comprehensive optical theory of the Microscope.

NOTE.—It may, I trust, be open to me, without breach of that respect which is due—and of which I am most deeply sensible—to Sir George Airy, and to the other distinguished men who have adopted his calculation, to suggest that some closer approximation to the true value of the light amplitude curve of the antipoint is desirable than his method of solving the problem affords. The difficulty may be illustrated in this way. Let the cone A A η in fig. 21 represent the principal or dioptric beam, and the other cone $A_1 A_1 \eta_1$ one of the diffracted beams transmitted by the same aperture. Now, according to Sir George Airy's way of viewing the matter, these two cones have a common middle point at C, where, of course, the undulation in both cones is in very nearly the same phase. Also, the surface A C A is monophasal—a wave-front focussing on the point η in the focal plane. The surface $A_1 C A_1$ is, on the other hand, polyphasal, and focussed in the point η_1. Airy determines the light amplitude at η by integrating over the surface A C A, and in like manner he determines the amplitude at η_1 by integrating over the surface $A_1 C A_1$.

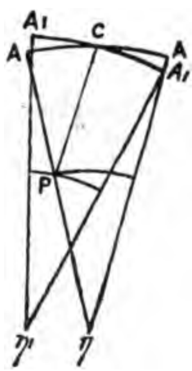

FIG. 21.

Let us now consider the resultant light phase at the point P in the diagram. This point is one point among many common to both cones, and here, therefore, the phase must be to a large degree common to them both. But it is quite obvious that such is not the case upon Airy's method of calculating. For, considered as a part of the diffracted cone $A_1 A_1 \eta_1$, the retardation of its phase is determined in relation to the contemporary phase in the wave-front A C A by the distance C P. But, considered as a part of the dioptric cone A C A, its retardation is determined by the shorter distance A P, and the phase difference of these paths may, by slightly varying the position of the point P, be made to run through the complete cycle of possible values, while the phase value at P throughout its movement remains substantially constant. It is evident, therefore, that Sir George Airy's two results—that is to say, the calculation of amplitude at the focal point, and that of amplitude at the point η_1—are incompatible with one another, and some more consistent mode of reckoning the light amplitudes in different parts of the antipoint is desirable.

The criticism suggests the alternative mode of computation. It is plain that all the diffracted light which escapes from the dioptric beam and lights up the disc of the antipoint must pass through the bounding

surface of the cone A A η. It seems, therefore, an obvious plan to compute diffraction, not from the *internal* surfaces A C A and A_1 C A_1, but from the external surface A A η. Upon this, which is believed to be a new problem, the following suggestions are offered with great humility, and in the hope that the problem itself, having been suggested for discussion, will receive the attention of some mathematician better qualified than the present writer to deal with it.

In the following diagram (fig. 22) let A...A represent the wave-front occupying the aperture, and let A A η be the dioptric beam. Also let the dark wedge cut out of the cone A A η be a part of the surface of the cone directed towards the point η_1 taken anywhere upon the focal plane.

It is manifest that we need not for the purpose of reckoning the illumination at η_1 consider the radiation from other parts of the conical

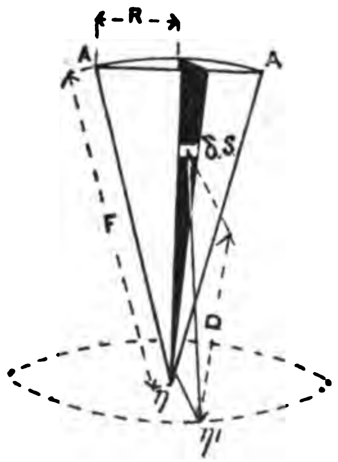

Fig. 22.

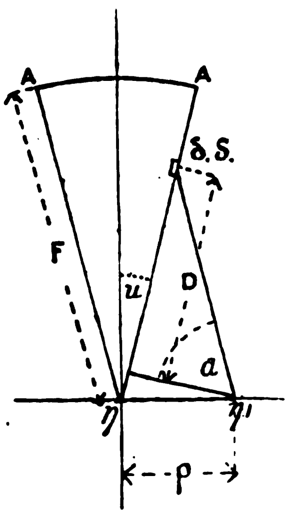

Fig. 23.

surface which are directed towards other parts of the focal plane. This follows at once from the symmetry of the figure. Furthermore, let ρ be the radial distance in the focal plane of the point η_1 from the true focus η, and let R = the semidiameter of the aperture. Let F = the optical distance from the aperture to the focal point η. Also, let δ S be an element of surface taken anywhere upon the radiant wedge, and from the centre point of δ S draw the straight line joining that point to the point η_1. Lastly, to complete the diagram, from the point η_1 draw a perpendicular upon the conical surface, and let the angle between these two lines, drawn from the point η_1 to the conical surface, be a. Also, let the distance, measured on the surface of the cone, between the point where the perpendicular meets the conical surface and the central point of δ S, be called D. It will be convenient to show these last mentioned magnitudes by another diagram (fig. 23), in which the angle a may

be depicted in the plane of the page. Writing u for the divergence angle of the beam A A η we have at once—

Distance of the middle point of δ S from η = D + sin $u\,\rho$.

Length of perpendicular from η_1 upon the cone = cos $u\,\rho$.

D = tan a cos $u\,\rho$.

Distance from δ S to η_1 = sec a cos $u\,\rho$.

The point at which the perpendicular from η_1 meets the surface of the cone may conveniently receive a name, since it must be frequently referred to in the following discussion. Since it is the point from which the normal to the surface of the cone issues which passes through η_1 in the focal plane, I propose to call it the normal point.

In reckoning the value at the point η_1 of the light radiated from the small surface δ S, there are seven matters to be taken into account, namely—

1. The area of δ S.
2. The projection along the axis δ S ... η_1 of this area.
3. The amplitude of the undulation in δ S.
4. A coefficient of condensation (or diffusion as the case may be) representing the change in light density involved in passing from δ S to η_1.
5. A coefficient of efficiency, depending upon the polyphasal character of the diffracted beam.
6. A coefficient of economy, expressing the fact that the original impulse in which the diffracted rays take their rise is itself travelling along the radiant surface, so that it is able to originate impulses which reach the point η_1 simultaneously from more points than one on the edge of the beam.
7. The phase in which the light arrives at η_1.

If we write ψ for the amplitude of the light undulation at η_1, and ϕ for its phase, we shall have—

$$d\,\psi = \{(1) \times (2) \times (3) \times (4) \times (5) \times (6)\}\, d\,\mathrm{D} \text{ and } \phi = (7)$$

To facilitate the writing out of these values, let the following symbols be adopted with reference to Fig. 23:

$$s = \sin u\,;\ c = \cos u\,;\ n = \frac{\mathrm{D}}{c\,\rho}\,;\ \mathrm{N} = \sqrt{n^2 + 1}$$

r = the radius of the cone at the level of δ S.

Moreover, I propose to substitute for the integral ψ a finite series having $\Delta\,\psi = \kappa\,\Delta\,\mathrm{D} = \kappa\,\lambda$, where κ represents the above coefficient of $d\,\mathrm{D}$ in the expression for $d\,\psi$ suitably modified to meet the change involved in the substitution of a short segment of one wave-length of the edge of the beam for the infinitesimal increment of D. Then—

1. The area of δ S = $m\,.\,\delta r\,.\,\lambda$, m being a constant to be determined by observation.

2. The projection of (1) = (1) cos a = (1) $\frac{1}{\mathrm{N}}$.

3. The amplitude = $\mathrm{M}_r = \frac{\delta\,\mathrm{R}}{\delta\,r}\,\mathrm{M}_0$; if M_0 = the amplitude in the aperture A A.

4. Condensation factor $= \frac{r}{\rho} = \frac{s\,(D + s\,\rho)}{\rho} = s\,(n\,c + s)$.

5. Efficiency factor. The following diagram (fig. 24) will aid the determination of this coefficient. Here $D_1 \ldots D_2 = \lambda$ measured on the edge of the beam $A\,A\,\eta$. D_n is the middle point of the segment, and $D_n \ldots \eta_1$ is the axis passing through the points D_n and η_1. Therefore, $\epsilon_1 \ldots \epsilon_2$ is the projection along this axis of $D_1 \ldots D_2 = \cos \alpha\,\lambda$. In $D_2 \ldots \epsilon_4$ take ϵ_3 such that $D_2 \ldots \epsilon_3 = D_1 \ldots D_2$. Then $D_1 \ldots \epsilon_3$ will be a monophasal surface, since every point in this surface is distant from the corresponding point in $D_1 \ldots D_2$ by a length, measured along the axis $D_n \ldots \eta_1$, equal to the distance between that corresponding point and D. Therefore, every point in $D_1 \ldots \epsilon_3$ is isophasal with D_1. Moreover, $\epsilon_1 \ldots \epsilon_4$, drawn parallel to $D_1 \ldots \epsilon_3$, is also a plane wave-front. It follows that $\epsilon_1 \ldots \epsilon_2$ represents a polyphasal surface, and that the phase range in $\epsilon_1 \ldots \epsilon_2 = (1 - \sin \alpha)\,2\,\pi$, and according to the well known expression for the efficiency of a polyphasal radiant surface—

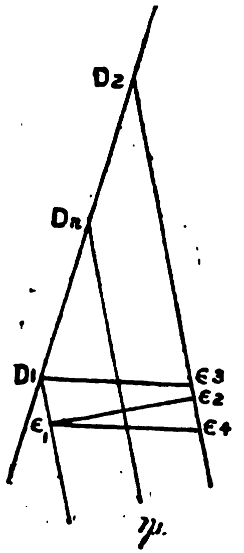

Fig. 24.

$$(5) \qquad = \frac{2 \sin \{(1 - \sin \alpha)\,\pi\}}{(1 - \sin \alpha)\,2\,\pi} = \frac{\sin \{(1 - \sin \alpha)\,\pi\}}{(1 - \sin \alpha)\,\pi}$$

$$= \sin \left\{ \frac{N - n}{N}\,\pi \right\} \cdot \frac{N}{(N - n)\,\pi}.$$

We have so far brought into the reckoning the phase changes due to the finite length of the small surface δ S, but not those due to its finite breadth. It is, however, obvious that the breadth of δ S will not be uniform, and not sensibly uniform, as we pass upward from the normal point towards the aperture A . . A, except, perhaps, in the case of an extremely short beam. In any ordinary case it will vary, and will vary very nearly in the proportion of the length of D ($= n\,c\,\rho$). We may therefore say, without sensible error, that the angle subtended at the point η_1 by the radiant wedge is for practical purposes invariable. Let this angle $= 2\,\beta$. Then from a horizontal line, equal to the breadth of δ S, through the point D_n, the extreme difference of optical paths to η_1 will be $(\sec \beta - 1)\,n\,c\,\rho$, and the corresponding phase range $(\sec \beta - 1)\,n\,\frac{c\,\rho}{\lambda}\,2\,\pi$. Let this angle be written $n\,\theta$, and we shall obtain for the whole impulse emitted from δ S when resolved along the $D_n \ldots \eta_1$ axis.

$$(5) \qquad = \sin\left\{\frac{N-n}{N}\pi\right\}\frac{N}{(N-n)\pi}\cdot\frac{\sin n\theta}{n\theta}$$

where θ is a small angle that cannot be mathematically determined, but must be ascertained by observation.

6. The Economy factor. If every point upon the surface $\epsilon_1 \ldots \epsilon_2$ received its light from a separate ray in the principal beam, the efficiency would be fully represented by the expression just found for (5). But we are integrating over a single element of the light cone, and the original impulse is travelling to a certain extent in the same direction as the diffracted light which it gives off. Thus the light source is, so to speak, economised, and a light source of shorter length than λ suffices to yield all the diffracted light which we have derived from $D_1 \ldots D_2$. Thus since the phase range in the surface $\epsilon_1 \ldots \epsilon_2$ is only $(1 - \sin a)\, 2\pi$, it is evident that the effective length of edge is $(1 - \sin a)\,\lambda$. Therefore

$$(6) \qquad = 1 - \sin a = \frac{N-n}{N}.$$

We may now collect these various results into one expression, as follows:

$$\Delta\psi = \frac{m\,.\,dr\,.\,\lambda}{N}\cdot\frac{d\,R\,M_0}{dr}\cdot s\,(nc+s)$$

$$\times \sin\left\{\frac{(N-n)\pi}{N}\right\}\frac{N}{(N-n)\pi}\cdot\frac{N-n}{N}\cdot\frac{\sin n\theta}{\theta}.$$

$$= m\,.\,d\,R\,.\,\lambda\,.\,M_0\,.\,s\,.\left\{\frac{nc+s}{N}\cdot\frac{1}{\pi}\sin\,.\,\frac{(N-n)\pi}{N}\cdot\frac{\sin n\theta}{\theta}\right\}.$$

It may be noted here that the expression $m\,d\,R\,\lambda\,M_0$ denotes the radiation upon the focal point from a small surface ΔS_λ (equal in area to the topmost segment of the radiant wedge) in the wave-front which passes the aperture A .. A. It may, therefore, be fitly taken for the unit of radiation for the given system, and expressed by the symbol M_1.

Accordingly the last expression may be written—

$$\Delta\psi = s\,.\,M_1\left(\frac{nc+s}{N}\cdot\frac{1}{\pi}\cdot\sin\frac{(N-n)\pi}{N}\cdot\frac{\sin n\theta}{\theta}\right) \quad . \quad (10).$$

The successive terms of this series are to be taken upon the principle of assigning one term to every segment of one wave-length measured from the normal point along the edge of the beam facing the point η_1, and therefore the values of n must be so chosen that—

$$D_1 = n_1\,c\,\rho = \frac{1}{2}\lambda;\; D_2 = n_2\,c\,\rho = \frac{3}{2}\lambda;\; D_3 = n_3\,c\,\rho = \frac{5}{2}\lambda, \text{ etc.}$$

It is plain that if n be taken very small $N = 1$ nearly, and, therefore, $\sin\frac{N-n}{N}\pi$ tends to $= 0$ as n approaches 0. Also if n becomes very large, $N - n$ tends to become $= 0$, so that in that case also $\sin\frac{N-n}{N}\pi$ approximates to 0.

The successive values of (10) obtained by giving successive values to n in that expression are not capable of being simply added together, for here the undulation is resolved in a direction perpendicular to the $D_n \dots \eta_1$ axis; which varies in position with the change of n. It is desirable, therefore, to obtain a resolution of these impulses in certain specified directions, and we may, for this purpose, select rectangular axes coinciding with the line through the normal point and the point η_1 and with the edge ray through δ S respectively. So resolved, $\Delta\,\psi$ will obviously yield two resultants, as follows, if we write x and y for these two axes in the order named.

$$\Delta\,\psi_x = \sin a\,\Delta\,\psi\,;\quad \Delta\,\psi_y = \cos a\,\Delta\,\psi,$$

that is to say, in place of (10) we obtain two equations as follows—

$$\left.\begin{aligned} \psi_x &= \Sigma(\Delta\psi_x) = s\,.\,\mathrm{M}_1\,\Sigma\left(\frac{nc+s}{\mathrm{N}}\,.\,\frac{n}{\mathrm{N}\,\pi}\,.\sin\frac{(\mathrm{N}-n)\pi}{\mathrm{N}}\,.\,\frac{\sin n\theta}{n\theta}\right) \\ \psi_y &= \Sigma(\Delta\psi_y) = s\,.\,\mathrm{M}_1\,\Sigma\left(\frac{nc+s}{\mathrm{N}}\,.\,\frac{1}{\mathrm{N}\,\pi}\,.\sin\frac{(\mathrm{N}-n)\pi}{\mathrm{N}}\,.\,\frac{\sin n\theta}{\theta}\right) \end{aligned}\right\} \quad . \quad (11)$$

or, more compendiously,

$$\Delta\,\psi_x = \frac{n}{\mathrm{N}}\,\Delta\,\psi\,;\quad \Delta\,\psi_y = \frac{1}{\mathrm{N}}\,\Delta\,\psi.$$

If the conclusions now reached are sound, it would seem to follow that much misunderstanding exists as to the distribution of light in the antipoint. It is, therefore, proper to say that these results are not put forward as being more than an approximation to the actual facts. To a certain extent the mode of computation now proposed is open to the same objection as that advanced against Sir Geo. Airy's method, namely, that it yields discrepant results in the region in which beams going to different points in the focal plane interpenetrate one another. But it will hereafter appear that a correction can be applied upon the present plan which gets rid of that difficulty, and yields a strictly coherent result. Furthermore, the ultimate test is experimental, and to me it appears that observation strikingly confirms the results to which these calculations point, and is as strikingly at variance with Sir Geo. Airy's curve. How far these impressions may be due to imperfect observations, I cannot presume to say. Some of the results which have emboldened me to submit the present hypothesis to public criticism are described in the foregoing paper, and some of these will be exhibited at the meeting of the Society by means of the apparatus with which I have observed them. Assuming, for present purposes, the approximate accuracy of the above expressions for ψ_x and ψ_y, the following seem to be legitimate inferences and matters of interest.

(*a*) The value of ψ is $\psi = 0$ at the focal point. This establishes a broad distinction between the direct and the diffracted light—the light that comes to focus within the cone and the light that strays outside it.

(*b*) The periodic factor $\dfrac{\sin n\,\theta}{n\,\theta}$ will cause certain regions in the radiant wedge to be wholly ineffective, and will limit the effective part

to a comparatively short length of the edge of the beam. It is readily deducible from this that the fringe will exhibit bright and dark bands consecutively, and that the falling off in brightness of the outer bands will be very rapid. It does not appear, however, that the dark bands will sink to zero illumination, as in Airy's curve.

(*c*) The form of (11) shows that the fringe must be a wave-front. For, recurring to Fig. 23, suppose the triangle $\delta S \eta_1$, P, to be shifted up a distance $= \lambda$ along the edge of the beam. Then, since the middle point D_n of every successive wave-length segment emits light in the same phase the series of (11) will be unchanged, except by the loss of a few wholly insignificant terms at the far end of the series, representing light from segments immediately below the aperture, where $\sin \alpha$ is sensibly $= 1$ and where consequently n is sensibly $=$ N, and therefore $\Delta \psi$ is sensibly $= 0$. It follows that in this new position of η_1 the values of ψ_x and ψ_y are severally identical with what they were in the original position. The same result would have appeared had we moved it 2λ, or 10λ, or $n\lambda$, n being any integer not immoderately large, that is to say, so large as to bring η_1 within a few wave-lengths of the aperture A . . A. Furthermore, if we take intermediate positions on the ray joining all these positions of η_1 we shall have corresponding intermediate values for the light phase, and in any given position the phase will, of course, change in time with the contemporary change in the generating edge ray of the beam. Therefore, along this supposed ray parallel to the edge of the beam, we have a regular succession of undulations moving forward with the velocity of light. Similarly with every other ray drawn parallel to the edge of the beam. We thus see that through a conical surface drawn normal to the edge of the cone we have a system of rays normal to that conical surface along which light undulations pass with the velocity of light. This seems to import that the disturbance set up in the region immediately surrounding a focussed beam takes the form of a conical wave-front, and from that it follows by a reversal of the reasoning on p. 20 (see fig. 12), that in the focal plane itself the antipoint will exhibit a zonal arrangement of phases, the light-phase being most retarded at the focal point. The phenomena resulting from that arrangement when the fringe has slipped off the beam and forms an antipoint, are worked out above in connection with figs. 13 to 20, and their experimental verification is there attempted.

Here it may be pointed out that if we now substitute this system of conical wave-fronts surrounding the true cone of the focussed beam for the complicated system of interpenetrating beams given off in many different directions by the radiant outer surface of the cone, we obtain a clear and perfectly coherent geometrical conception of the simple diffraction fringe from which the antipoint is eventually formed.

(*d*) This last case leads naturally to the next. So far we have considered only antipoints and the simple cones which give rise to them. More complicated cases arise in practice when light is radiated from surfaces of finite magnitude. Upon this subject I have very little to offer, for as yet I have hardly broken ground in that direction. But one conclusion of great importance seems obvious. It is that the diffraction fringe upon the edge of a luminous area will have a regular

gradual distribution of phases parallel to the edge of the boundary, rising from a phase equal to the external phase of the individual antipoint at the outer edge of the diffraction fringe to a value which is the average of the phases in one half of the antipoint over the boundary itself. This is obvious, for the light on the outermost edge is unmixed, and the light at every point on the boundary is the summed light of one half of the antipoint. Proceeding inward from the boundary we find the phase still increasing, for the region near the boundary is lighted up by something more than half the antipoint, and the additional light consists in more than the total average proportion of the light of the innermost zones of the antipoint. But when we get to a point equal to the radius of the antipoint within the true boundary, we reach a region where the light on every point is the integral of all the light from a single antipoint. Here, then, the light phase must have returned to the phase on the boundary, since the average phase of the complete antipoint must be the same as the average of the semi-antipoint, seeing that one half of every zone enters into the semi-antipoint, and the proportional value of every zone in relation to the whole illumination is therefore the same in both cases. This consideration points to the existence of a doubly conical wave-front with unequal surfaces, and yields at once a forecast of certain very striking phenomena which are, as the foregoing paper shows, very strikingly verified by experiment. (See above, p. 23.)

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Mendel's Law and the Heredity of Albinism.‡ — W. E. Castle and G. M. Allen find that complete albinism, without a recorded exception, behaves as a *recessive* character in heredity. Partial albinism is a mosaic condition, in which the dominant pigment-forming character and the recessive albino character are visible in different parts of the same individual.

Albinism apparently complete may in reality conceal traces of the pigment-forming character, either in an active or in a latent condition. Albinos that are thus constituted are in reality mosaics of the contrasted characters, but with the pigment-forming character (ordinarily dominant) occurring in a condition of partial or complete latency. When bred to other albinos they uniformly produce albinos, hence they may for convenience be distinguished as *impure* recessives. In guinea-pigs and rabbits the impurity of recessive individuals is, in certain cases at least, visible; in mice it apparently is not.

Cross-breeding is able to bring into activity latent characters or *latent elements* of a complex character. This is probably the true explanation of many cases of reversion. Conversely, it is able to cause one or another element of a complex character to become latent and to remain so under close breeding. This probably explains how races of black or yellow mice may be obtained by crossing wild grey mice with albinos.

The Mendelian doctrine of gametic purity is fully substantiated by

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Mark Anniv. Vol., 1903, pp. 379–98.

experiments in breeding mice, guinea-pigs, and rabbits, but with the important qualification stated in the preceding paragraph—a qualification which really enhances the practical utility of Mendel's doctrine in its everyday application by breeders.

Radium Effect on Development of Amphibia.* — A. Schaper has proved experimentally that radium rays have a definite inhibitory effect upon cell-division in the frog, etc., also on embryonic differentiation, growth, and regenerative processes. These effects are observable only after a longer or shorter latent period. On frog larvæ radium emanations had an injurious and finally fatal effect.

Abnormal Eggs in Fowls.†—J. Kunstler discusses eggs with two separate shells, eggs with a double shell, double eggs, eggs without yolk, dwarf eggs, and so on. A frequent factor is a lack of tone in the oviduct, the usual movements are disturbed, the egg returns on its path. Foreign bodies may ascend from the cloaca and become surrounded by a shell. A mass of albumen may be enveloped in a shell; and so on.

Polymorphism of Spermatozoa.‡—A. Gruvel brings together some of the cases of dimorphic spermatozoa,—in *Paludina vivipara*, *Notommata sieboldii*, *Asellus aquaticus*, *Pygæra bucephala*, *Staphylinus*, *Cybister roeselii*. In *Ascaris megalocephala* there are said to be four forms of spermatozoa, but only one form is capable of fertilisation. Gruvel has studied the spermatozoa of *Balanus perforatus* in which giant forms occasionally occur, apparently in individuals separated widely from one another. These giant spermatozoa may be adapted to cross-fertilisation at a distance; being stronger, they can move more rapidly, and further.

Factors of Morphogenesis.§—Tad. Garbowski discusses *Trichoplax adhærens* and other Mesozoa, the processes of gastrulation and cœlom-formation, and the scope of physiological morphology.

He rejects the homology of the germ-layers, the gastræa-theory, the cœlom-theory, and much more. He insists that a scientific interpretation of the pedigrees of animals must be based on an observational and experimental study of the formative processes which actually occur in morphogenesis.

Œstrous Cycle in Ferret.‖ —F. H. A. Marshall finds that the female ferret is monœstrous, and may have one, two, or three sexual seasons within a year. The "heat" periods, however, are usually restricted to the spring and summer months. During the œstrous cycle the non-pregnant uterus experiences in succession periods of rest, of growth, of degeneration, and of recuperation. The changes occurring during these periods afford proof of the homology between the menstrual cycle of the primates and the œstrum of the lower mammals. Ovulation occurs probably at the commencement of the œstrous period, but only as a

* Anat. Anzeig., xxv. (1904) pp. 326-37.
† Mém. Soc. Sci. Bordeaux, sér. 6, iii. (1903) pp. 65-72 (7 figs.).
‡ Tom. cit., pp. 273-9.
§ Morphologische Studien, Als Beitrag zur Methodologie zoologischer Probleme. 4to. Jena (1903) vii. and 189 pp., 6 pls.
‖ Quart. Journ. Micr. Sci., xlviii. (1904) pp. 323-45 (3 pls.).

result of sexual intercourse. Since coition and ovulation take place after the pro-œstrum, it is clear that the degeneration stages of the pro-œstrum cannot be of the nature of an undoing, in consequence of the absence of a fertilised ovum, of preparations made during the earlier growth stages.

Implantation of Ovum in the Gopher.*—T. G. Lee gives an account of the fixation of the ovum in this rodent (*Spermophilus tridecemlineatus*), which differs from its relatives, and, further, from any other mammals yet described in the nature and history of the temporary "*fixation-mass*" formed by the trophoblast.

Development of Pulmonary Arteries in Roe-deer.†—T. Sakurai finds that the pulmonary arteries arise first from both pulmonary arches as in man, but gradually the left passes over to the right pulmonary arch approaching the right artery. The portion of the right pulmonary arch between the angle of division of the arches and the origin of the left pulmonary artery forms the common origin of both pulmonary arteries.

Development of Mammalian Kidney.‡—J. Janošik has investigated certain early stages of the urogenital system in the pouched marmot. He finds the first certain appearance in embryos with ten distinct and one incipient mesoblastic somites. It arises opposite the seventh somite proximally as a grouping of somatopleure and splanchnopleure cells against the somites; the cœlome is slightly indented into this group. The section situated between the twelfth and fifteenth or sixteenth somites in embryos showing these, is regarded as transitional to the mesonephros. The origin of this division of the mesonephros takes place as follows. The middle plates detach themselves both from the mesoblastic somites and from the cœlomic epithelium, and from them there arises a cellular strand which falls into separate cell masses not segmentally arranged. In these cell masses a lumen arises, which is transformed into a vesicle from which a small canal grows out. On the median end of each of these canals a glomerulus is formed, while the lateral end opens into the Wolffian duct. Thus connections arise similar to those known to occur in birds.

Regeneration of Tail-tissues in Anuran Larvæ.§—P. Wintrebert gives the results of experiments on the larva of *Alytes*. He finds that regeneration of the tail depends upon the reconstitution of the supporting apparatus, more especially the axis of central support round which the embryonic mesenchyme can be organised. The median "lophiodermic raphe" of the limbs constitutes a sufficient apparatus of support to admit of the regeneration of the cord. The connective fibrous neural and aortic canals are powerless, with the organs they inclose, to supply the place of the missing cord or to regenerate it. They may in fact by their re-union oppose its extension and thus limit

* Mark Anniv. Vol., 1903, pp. 417–35 (2 pls.).
† Anat. Anzeig., xxv. (1904) pp. 321–6.
‡ Arch. Mikr. Anat., lxiv. pp. 214–34 (2 pls.).
§ Comptes Rendus, cxxxix. (1904) pp. 432–4.

the regeneration of the tail. It is hence suggested that in animals the absence of regeneration in an organ may be caused by the stoppage of development of the supporting tissue due to the fibrous growth of the cicatrix.

Development of Amphibian Excretory System.*—D. P. Filatow discusses the development, structure, and functions of the pronephric glomus, and the development of the mesonephric tubules. He explains certain differences in the first stages of the tubules in Urodela and Anura, referring particularly to the process of separating the connecting group of cells from the lateral plate, and the mode of approach of the group to the duct. In the Anura the group is first detached before approaching the duct, while in Urodela the process of separation is prolonged, with the result that a different formation appears. He thinks that this explanation may account for peculiarities of the tubule formation in other animal groups.

Development of Ventral Nerves in Selachii.†—H. V. Neal discusses the spinal ventral nerves in the spiny dogfish (*Squalus acanthias*). Positive conclusions in regard to some important questions have been reached. (1) The neuraxones of the spinal ventral nerves of Selachians develop like those of the Amniota as processes of neuroblast cells. In their growth they are secondarily surrounded by sheath-cells. (2) Medullary cells, but not those that form the neuraxones, migrate into the ventral nerves in the early stages of development. (3) The migrant medullary cells form the neurilemma sheaths, but take no part in the formation of the neuraxones or ganglia of the ventral nerves. (4) The epineurium and perineurium sheaths are in chief part added to the embryonic nerve from the adjacent mesenchyme.

In his summary the author states that neuroblasts and spongioblasts are undifferentiated in the early stages of the ventral nerve; the first neuraxones are formed before the migration of the cells which produce them; the "germinative cells" of this are simply mitotic cells; no neuroblasts migrate from the wall of the neural tube; their migration is entirely within the wall, and is the passive result of the multiplication of cells near the lumen of the tube; neuraxones of spinal ventral nerves are formed exclusively by medullary cells; the cells of ventral nerves are not concerned with the formation of neuraxones; they form the neurilemma and possibly also the connective-tissue sheaths of the nerves, to which mesenchymatous cells probably also contribute; the cells of the forming ventral nerve are migrant medullary elements, to which are subsequently added cells from the adjacent mesenchyme; the first connection of ventral nerve and myotome is not an intimate neuromuscular attachment; there is no primary cellular connection such as has been postulated by Sedgwick.

Torus longitudinalis of Teleost Brain.‡—P. E. Sargent discusses this archaic portion of the mesencephalic roof formed in the Teleosts.

* Anat. Anzeig., xxv. (1904) pp. 33–47.
† Mark Anniv. Vol., 1903, pp. 291–313 (3 pls.).
‡ Tom. cit., pp 399–416 (1 pl.).

from the mesial and primitive portion of the tectum opticum, constricted off, and, as it were, left behind in the enormous development of the tectum in this aberrant group.

In its early development in the ganoids it is the result of purely mechanical causes, the rapid growth in the adult of the "nucleus magnocellularis" producing a downward bending of the mesencephalic roof on either side of the median plane.

Mechanical causes are still plainly operative in the Siluridæ, but in other Teleosts the torus appears, at an early stage of ontogenetic development, as the result of phylogenetic causes. Though the torus longitudinalis is a structure which first attains an independent and definite form in the Teleosts, and in that group only, its essential elements are perhaps the most archaic of the mesencephalic roof. The structure and functions are also discussed.

Development of Body Cavity and Gonads in Salmonidæ.*—U. Böhl has studied this in trout and salmon embryos. He finds that its first appearance in the trout is on the 25th day after fertilisation. It arises as a cleavage between somato- and splanchnopleure in the region of the lateral head plate. On the 28th day the body cavity has increased in the cranial, and especially in the caudal direction; its development is closely connected with that of the gut. At 38 days, growth in length has ceased, whilst lateral development, coincident with yolk absorption, has considerably increased. In salmon embryos of 40 days (twenty segments) the body cavity of the tail is completely separate from that of the yolk-sac. Later the yolk-sac body cavity in the region of the 14th to 18th trunk segments is drawn into the trunk body cavity; the yolk-sac, which has collapsed from the 18th segment onwards, forms for a time a long mesenteric formation, through which the ventral body partition is joined to the ectoderm. Later it is completely absorbed.

In trout the first genital cells were not found before the 25th, and in salmon the 31st day. There are two stages of development of the genital organs. The first, that of the genital ridge, was observed in the salmon on the 60th day. The second, that of the genital fold, arises from the ridge, and may be recognised in the salmon on the 85th day. In its anterior part it never extends beyond the 4th, and in its posterior or caudal, never beyond the 38th. Three kinds of cells arise from cœlome cells, viz. indifferent, follicle, and genital cells.

Relation of Nervous System to Developing Musculature.†—R. G. Harrison has investigated this subject experimentally. The spinal cord of embryos of *Rana* was removed before histological differentiation in either muscular or nervous tissue had begun. This did not hinder the differentiation of the contractile substance in the normal manner, nor the grouping of the individual fibres into muscles. Larvæ were reared under continued narcosis of acetone-chloroform, which stops all voluntary movements, including those of respiration, while the heart-beat is scarcely affected. The functions are rapidly restored by removal from the drug. Larvæ reared in this way and imbedded side by side

* Morphol. Jahrb., xxxii. (1904) pp. 505-86 (1 pl.).
† Amer. Journ. Anat., iii. (1904) pp. 197-220.

with normally reared forms showed no marked contrast in the muscular tissue. The significance of these results is discussed.

b. Histology.

The Histology of the Cell.* — E. Rohde discusses very fully the insufficiency of present cell theory, the independence of the nucleus, the relation of the nucleus and cell body of the Metazoa (and Infusoria) to the central body (Bütschli) of bacteria, and other cell problems. A brief enumeration of some of his points on the first head may be given. Embryonic syncytia occur and frequently play a great part in histogenesis. Especially instructive in the genesis of different tissue is the fact that cells clearly formed but undifferentiated blend into a syncytium from which diverse tissues are developed. An illustration of this is found in the development of the œsophagus of *Ascaris*. The œsophagus consists of a thoroughly uniform fundamental substance which simultaneously generates first a thick cuticle; secondly, powerful supporting fibres of different systems; thirdly, well developed muscle fibrils, which are said to be diagonally striped. Proof of another kind is found in the fact that many formations regarded as cells are the product of several quite different cells, e.g. Tubularian egg-cells, according to Doflein. Labbé regarded the ovum in this case as a plasmodium, which arose by the blending of several oocytes. Schneider observed the same in *Synapta*.

Relations between Nucleus and Cytoplasm.†—Stanislas Maziarski describes three kinds of more or less pseudopodium-like processes which extend towards the base of the cell from the nucleus into the cytoplasm in the hepato-pancreatic tubules of various marine Isopods (*Cymothoa, Nerocila, Anilocra*). The prolongations may absorb substances from the cytoplasm, or may conduct products from the nucleoplasm to the cytoplasm. In any case, they point to close inter-relations between the two.

Comparative Histology of Ducts and Accessory Glands of Male Gonads.‡—R. Disselhorst is the author of the fourth part of Oppel's treatise on the comparative histology of Vertebrates. He deals with the minute structure of the ducts and accessory glands of the male reproductive system. Fifteen sections deal with these in fishes, amphibians, reptiles, birds, and the chief orders of mammals. Two final sections sum up results, and give a short sketch of the history of the subjects. Then there are some physiological notes. This part maintains the high standard of its predecessors, for which the editor was responsible.

Epithelium of the Epididymis.§ — Zenon Jeleniewski has studied this in cat, dog, mouse, rat, guinea-pig, and hedgehog. The epithelium

* Zeitschr. wiss. Zool. lxxviii. (1904) pp. 1–148 (7 pls.).

† Bull. Internat. Acad. Sci. Cracovie, 1904, pp. 345–66 (2 pls.).

‡ Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere. Herausgegeben von Prof. Albert Oppel. Vierter Teil. Ausführapparat und Anhangsdrüsen der männlichen Geschlechtsorgane. Prof. R. Disselhorst. Jena (1904), x. and 432 pp., 435 figs. and 7 pls.

§ Anat. Anzeig. xxiv. (1904) pp. 630–40 (8 figs.).

of the beginning of the epididymis—the vasa efferentia and coni vasculosi—consist of ciliated cells, which from time to time secrete and lose their ciliary apparatus, regaining it after the secretory process is over. These cells contain "*diplosomes*," which are quite distinct from the centrosomes visible at the poles of the achromatin-spindle of dividing cells. The secretory activity leads to the gradual disintegration of the cells, which are then replaced. Many other histological details are communicated; we have simply noted the salient points.

Peculiar Structures in Hepatic Cells.*—Eugenie Koiransky gives a detailed account of peculiar rod-like or strand-like structures observed within the cells of the liver in frog, newt, and salamander. They are often substantial, and proceed from the nucleus towards the periphery of the cell, which they often reach. It is maintained that there is in secretion a shunting and migration of chromophilous substance towards the capillaries along protoplasmic strands, controlled by the kinetic potencies of the protoplasm, and that this is followed by a granular disruption, a chemical change, and a final solution of the substance in the vicinity of the capillaries.

Position of Glycogen in Liver Cells.†—O. Petersen points out that great care needs to be exercised in explaining alcohol-fixed preparations with reference to the position of glycogen within the cells. For this the method of freezing sections is more reliable. In cases of lateral penetration of alcohol the glycogen lies on the same side of all the cells, viz. remote from the side of penetration, as if pushed in front of the alcohol.

Islets of Langerhans in Teleostei.‡—J. Rennie has investigated the pancreas of a large number of bony fishes, and finds that these islets are a common character in the group. In a number of species there is an encapsuled islet ("principal islet") of relatively large size, of constant occurrence, and with definite relations, whose association with the pancreas is frequently extremely slight. In some forms it was the only body of this nature found. The smaller islets which do not appear to be constant in number, probably originated as accessory bodies, but are now established as definite organs. It is concluded that these islets are blood glands, whose relation with the pancreas is secondary. This has been brought about in Teleostei mainly by the tendency of the diffuse pancreas to envelop or invade other tissues. In the case of these so-called islets in the compact pancreas of Teleostei, and also of higher animals, the closer relation is due to the common embryonic origin of the two tissues. The primitive condition is that exhibited by Teleostei with diffuse pancreas, where the islets are both morphologically and functionally separate.

Granular Cells in Epidermis of Ammocœtes.§—N. Loewenthal makes some notes on these cells. He describes the thread-like continua-

* Anat. Anzeig., xxiv. (1904) pp. 435–56 (6 figs.).
† Op. cit., xxiv. (1904) pp. 72–5.
‡ Quart. Journ. Micr. Sci., xlviii. (1904) pp. 379–405 (3 pls.).
§ Anat. Anzeig., xxv. (1904) pp. 81–94.

tions which are directed to the upper surface of the epidermis. They can be traced within the cell up to the granular zone. In favourable cases there can be distinguished on the end part of the continuation a spindle-shaped enlargement and delicate wavy threads ("terminal thread-apparatus"), which pass through the granular part of the cell. He also describes amitotic divisions and constrictions in the nuclei of these cells.

Structure of Human Hypophysis.* — V. Scaffidi finds that the human hypophysis exhibits two fundamental kinds of cell which are sharply distinguished from one another, viz. one stainable with Orange G, and the other with Acid fuchsin. The cyanophile cells of Schönemann are to be regarded as fuchsinophile elements in an advanced phase of elimination of plasma granules. The nuclear masses and the isolated nuclei (the definite characters according to which they are recognisable as belonging to the fuchsinophile cells) must be regarded as an expression of the last phase of this elimination process. Probably the other nuclei which are surrounded by narrow fringes of protoplasm (to which the qualities of the above do not belong) may be considered as fuchsinophile cells in a stage of reconstruction. Two forms of cell colourable with Orange G are distinguishable, to which two different functional phases can be ascribed. Both the fundamental types (Orange G and Acid fuchsin) have probably the function of elaborating definite substances which together represent the secretion of the gland.

Research Methods on Human Brain.†—P. Flechsig gives a concluding paper containing critical observations on research methods on the cerebral cortex.

Contraction of Smooth Muscle Cells.‡ — E. Forster states that these cells contract in such a way as to coil up spirally. This is true for smooth muscle cells, for heart muscle, and for the diagonally striped cells of amphibia. The nucleus shares passively in this spiral contraction, so that it is rod-like when the cell is passive and wound spirally as the cell contracts. The extent of contraction of the cell may be known from the degree of the nuclear spiral. The "*Stauchung*," "*Fältelung*," "*Schlängelung*," of the nucleus spoken of by various authors, and the "nuclein-spiral" described, is nothing other than the spiral contraction here explained.

Lymph Hearts of Rana.§ — M. H. Hoyer finds that the lymph hearts, like the blood hearts, are very perfectly developed organs, in which the entrance and exit is exactly regulated by a system of valves. The circumstance that there are several lymph hearts on each side has probably its explanation in the phylogenetic development of the Anura. The larvæ are provided on each side with several lymph hearts, and Weliky has shown that the Urodela possess a large number of these segmentally arranged.

* Arch. Mikr. Anat., lxiv. (1904) pp. 235-57 (1 pl.).
† Ber Sachs. Ges. Leipzig, lvi. (1904) pp. 177-248.
‡ Anat. Anzeig., xxv. (1904) pp. 338-55.
§ Bull. Intern. Acad. Sci. Cracovie, v. (1904) pp. 228-37.

Comparative Histology of Cartilaginous Cells.*—Joannes Chatin has a brief note on the extraordinary polymorphism of cartilage cells, which are usually described as ovoid or spheroidal except in rare cases. The fact is that it is a very variable element, occurring in spheroidal, cylindrical, claviform, ovoid, angular, multilobate, branched, stellate, and other shapes, all connected by intermediate phases.

c. **General.**

Phototropism in Animals.†—Em. Rádl has made many experiments, especially with Arthropods, on the wide-spread phenomenon of phototropism. Many animals, from Cœlentera to Molluscs, orientate their body in relation to the direction of light; many move actively to or from the light, orientating themselves meanwhile. It is a primitive reflex, and though it is not definitely proved, the author says, in Protozoa, it occurs familiarly in unicellular plants. Many interesting subjects are discussed—the behaviour of animals on a rotating turntable, the compensatory head-movements of insects, nystagmus in insects, and the flight of moths and the like into the flame. The phototropic phenomena are considered in relation to other tropisms, and in connection with the general problem of orientation. Rádl's general position is that, under the influence of external and internal forces, working, so to speak, in opposed couples, the organism comes to assume a position of static and also physiological equilibrium in reference to the direction of the light.

Coloration in Mammals and Birds.‡—J. L. Bonhote seeks to show that the colour of a bird or mammal is primarily due to "activity of nutrition and function." This he terms "vigour," which is dependent on (*a*) climate, containing two factors, temperature and food, and (*b*) the rise and fall of sexual activity. Where conditions for high vigour exist, the majority of the animals will be brightly coloured. The individual vigour of various species and groups will differ, and one animal may be able to maintain a full vigour under conditions which would be impossible to another. This will account for some of the Polar animals becoming strongly coloured, e.g. musk ox, raven, penguin. Shortly before the moult in many animals the colour of the pelage fades, beginning along certain definite areas and from certain centres, termed "pœcilomeres;" this bleaching is physiological, and the patches so produced thus owe their inception to internal rather than external causes.

Relation of Oxidation to Functional Activity.§—Sir John Burdon-Sanderson opened a discussion on this subject at the British Association Meeting at Cambridge. He particularly contrasted the chemical processes of gland function and muscle function. Whereas the former is not in any marked degree katabolic, the dominant process in the oxidation which is inseparably associated with the performance of muscular function *is* katabolic. Oxygen seems to play two parts in metabolic

* Comptes Rendus, cxxxix. (1904) pp. 489-91.
† Untersuchungen über den Phototropismus der Tiere. 8vo. Leipzig (1903) 188 pp.
‡ Journ. Linn. Soc. (Zool.) xxix. (1904) pp. 185-7.
§ Nature, lxx. (1904) pp. 590-3.

processes, one of which is prominent in muscle, and is responsible for the final oxidation of explosive material, while the other, which is more accentuated in glands, is akin to a building-up process, as it is involved in the elaboration of new material.

Outlines of Zoology.*—R. Latzel has prepared a fourth revised edition of a class-book which has had wide and prolonged favour in Germany, Graber's "Leitfaden der Zoologie." It is a terse and accurate synopsis of the general characters of the various classes of animals, somewhat too all-embracing and informative to be educationally inspiring, but of service, doubtless, as an *index rerum* in association with more vital studies. It is very copiously illustrated, and the coloured plates are admirable.

Eyes of Vertebrates.†—O. Schnaudigel takes an interesting comparative survey of the eyes throughout the Vertebrate series—discussing, for instance, peculiar cases like eyes of cave animals and deep-sea fishes, and indicating the chief structural differences observed in a comparison of lenses, accommodation-apparatus, and retina in various types.

The Mammalian Cribrum.‡—W. Blendinger has investigated this structure in a series of Mammals. In origin it consists of lateral, more or less vertical folds, the cribral sacs. On the embryonic cribrum there arise three main side sacs, pro-, meso-, and metacribrum, the entrance to which is perpendicular to the main axis of the nasal canal. In later stages of growth two intermediary sacs are added, the epi- and paracribrum. The growth of all the five continues in a lateral and dorso-ventral direction; the posterior end of the entrance to each is flanked by an olfactory torus. These are termed endoturbinal tori; the corresponding sacs are distinguished as pro-, epi-, etc., turbinals. The form of the sacs is, in varying degrees in different species, further complicated by homologous side pockets, bursa-dorsalis, -externa, and -ventralis, which again form secondary niches. Between all the side spaces arise cartilaginous and ossifying partitions, the endo- and ecto-turbinal lamellæ. The sinus maxillaris is a product of the procribrum, the other pneumatic hollows arise partly out of the procribrum and partly from the other cribral sacs. The paper is accompanied by historical and critical observations by Dr. A. Fleischmann.

Whalebone Whales of Western North Atlantic.§—F. W. True discusses these in a memoir, the size of which is worthy of the subject. The conclusions reached are:—(1) that the species in the Western North Atlantic are the same as those in the Eastern North Atlantic; (2) that these are the Bowhead, or Greenland Right whale (*Balæna mysticetus*), the Black whale (*B. glacialis*), the Humpback (*Megaptera nodosa*), the Sulphurbottom (*Balænoptera musculus*), the common Finback (*B. physalus*), the Little Piked whale (*B. acuto-rostrata*), and probably the Pollack whale (*B. borealis*); (3) that the range of the Humpback extends

* Graber's Leitfaden der Zoologie für höhere Lehranstalten. Bearbeitet von Dr. Robert Latzel. 4th revised edition, 8vo. Leipzig (1904) 232 pp., 474 figs., 4 coloured plates, and a map of distribution.

† Ber. Senckenberg. Nat. Ges. 1903, pp. 187–202.

‡ Morphol. Jahrb., xxxii. (1904) pp. 451–504 (2 pls.).

§ ...n Contributions to Knowledge, xxxiii. (1904) pp. 1–332 (50 pls.).

southward at least as far as 18° North Lat.; and (4) that the probability of the identity of the North Pacific species with those of the North Atlantic is strengthened by the evidence collected.

As evidence is strengthened regarding the specific identity of the whales of the North Atlantic and North Pacific, the belief that the same species of large whales range all over the globe is also strengthened. It is well known that whales closely resembling *Megaptera nodosa*, *B. acuto-rostrata*, *B. musculus* and *B. physalus*—to mention no others—occur in the South Atlantic and the Antarctic seas, and also, the second and last, at least, about New Zealand. But even if it should be proved that the species of large whalebone whales are cosmopolitan, it does not follow that the individuals constituting these several species range throughout the globe. The probabilities are much against such world-wide movements, and in the case of the Right whale it appears to have been demonstrated by Maury that individuals do not cross the equator. The memoir is sumptuously illustrated.

The Roman Mole.*—L. Camerano has made an elaborate comparison between the Roman mole (*Talpa romana* Oldfield Thomas), the common mole *Talpa europæa*, and *T. cæca* Savi. His detailed measurements of many parts illustrate minutiose taxonomic work. He has no doubt that *T. romana* is a very distinct species. The common mole occurs in various parts of Italy, but does not differ from that of other countries. Variations with fused eyelids occur; this is *normal* in *T. cæca*, and the taxonomic value of *T. cæca* requires further study.

New Order of Ungulate Mammals.†—C. W. Andrews has come to the conclusion that the remarkable genus *Arsinoitherium* (from the Eocene of Egypt) must be referred to a new sub-division of the Ungulata of equal value with the Amblypoda and Proboscidea, to both of which a certain degree of relationship may exist. For this new order the name Barypoda is proposed, in allusion to the massive character of the limbs. For another genus *Barytherium*, it seems safest to erect a sub-division of the Amblypoda, the Barytheria, equivalent in value to the Dinocerata.

Forest Pig of Central Africa.‡—Oldfield Thomas notes that R. Meinertzhagen has procured two skulls and some portions of skin of the "forest pig" reported by Sir Henry Stanley and Sir Harry Johnston. The trophies show that the animal represents a most interesting new genus connecting the aberrant wart-hog (*Phacochærus*) with the more ordinary Suidæ, such as *Sus* and *Potamochærus*. It may be regarded as an early stage in the specialisation of the wart-hog. The name proposed is *Hylochærus meinertzhageni*.

Material for the Study of Ruminants.§—Einar Lönnberg makes a contribution to the comparative anatomy of the wild ruminants,—the black-buck of India (*Antilope cervicapra*), *Cephalopus ogilbyi*, *C. melanorhæus*, and *C. silvicultor*, *Boselaphus tragocamelus*, and *Anoa*. In

* Mem. R. Acad. Sci. Torino, liv. (1904) pp. 81–128 (1 pl.).
† Geol. Mag., 5th decade, i. (1903) pp. 481–2.
‡ Nature, lxx. (1904) p. 577.
§ Nova Acta R. Soc. Sci. Upsala, xx. (1904) Sect. ii. Art. 2, pp. 1–61 (2 pls.).

some instances the adaptations of the intestinal canal to the diet, and certain features of the ontogenetic development of some of the organs are brought to light.

Iridescence of Pigeon's Neck.*—R. M. Strong has made a careful analysis of the metallic colours or iridescence of the sides of the neck of the grey domestic pigeon. The phenomenon is confined to the dorsal surfaces of the distal portions of the feathers; it is not due to diffraction, and Gadow's refraction-prism hypothesis is untenable. The metallic colours are probably thin-plate interference colours or Newton's rings effects, which are produced where spherical pigment granules come in contact with the outer transparent layer. The pigment also has the very important function of absorbing light not reflected to the eye as metallic colour. The colours seen without a Microscope are mixtures of colours from innumerable small points.

Fossil Plumage.†—C. R. Eastman comments on the many chances against the preservation of feathers or their impressions. Yet we know the plumage of *Archæopteryx*, *Hesperornis*, and *Palæospiza*. Moreover, from the Upper Eocene limestone of Monte Bolca in the Veronese—a marine horizon—a few feathers have been obtained, and Eastman describes a small fossil Carinate feather recently acquired by the Museum of Comparative Zoology at Cambridge. It is possible to distinguish each separate barb and even the barbules.

Respiratory Rhythm in Chamæleon.‡—MM. Couvreur and Gautier have analysed the respiratory mechanism in *Chamæleo vulgaris* with the following result. The flank movements correspond to the respiration; they are slow, being one per minute at 20° C. There are three pauses in the respiratory movement. After full inspiration there is a short pause, then a half expiration followed by a long pause of half a minute or over, then the end of expiration, between which and the next inspiration there is another pause. Raising the temperature effects a shortening of the pauses. It is not known whether the pauses are effected by the closing of the glottis or are independent of it.

Variations of Toads.§—L. Camerano gives a detailed account of the variations in *Bufo viridis* Laur., *B. mauritanicus* Schlegel, and *B. regularis* Reuss. His memoir is an illustration of elaborate "somatometric" work.

New Apodous Amphibian from India.‖—A. Alcock describes *Herpele fulleri* sp. n. from Cachar, in the province of Assam. Three other species are known, one of which occurs in Panama and another in West Africa. This raises a problem in distribution, and the author seeks for some light in comparing the distribution of the Cæciliidæ in general with that of certain sublittoral genera of hermit-crabs. The facts suggest the hypothesis of a "Tethyan Sea" or chain of archi-

* Mark Anniv. Vol., 1903, pp. 263–77 (1 pl.).
† Amer. Nat., xxxviii. (1904) pp. 669–72 (1 fig.).
‡ Ann. Soc. Linn. Lyon, l. (1904) pp. 159–60.
§ Mem. R. Accad. Sci. Torino, liv. (1904) pp. 183–280.
‖ Ann. Nat. Hist., xiv. (1894) pp. 267–73 (1 pl.).

pelagoes that may have extended, under uniform conditions, north of the Equator, from Panama eastwards, by way of Africa, into South-East Asia. Of this sea the hermit-crabs in question might be supposed to be part of the residual littoral or sub-littoral fauna, while *Herpele* might be one of the relics of the land-fauna of its southern coasts.

Cranial Osteology of Fishes.* — W. G. Ridewood describes the skull in the families Mormyridæ, Notopteridæ, and Hyodontidæ. He considers that these families, though more closely related *inter se* than is any one of them with any other family of Malacopterygian fishes, are not more intimately related with one another than was previously assumed to be the case. As far as cranial characters are concerned, they afford no basis for a phylogenetic arrangement. The three families must remain, as hitherto, the terminals of a radiating system.

Edestus and its Relatives.†—C. R. Eastman refers to the uncertainty as to the nature of *Edestus* fossils, some authorities referring them to the jaws, and others to the external armature of an Elasmobranch. He has been able to show that the fused segments of *Edestus*, *Campyloprion*, and *Helicoprion* are veritable teeth corresponding to the symphysial series of *Campodus*, which are enormously enlarged as compared with those of *Cestracion* and other recent sharks; and also that these four Carboniferous and Permian genera together constitute a remarkable series, in which the progress of evolution is readily traceable. Beginning with *Campodus*, he shows in the species of *Edestus* and *Campyloprion* the progressive stages by which the typical orodont dentition of the Lower Carboniferous passed into the excessively modified spirals of *Helicoprion* before the close of the Palæozoic.

Natural History of Amia calva.‡—Jacob Reighard has made a careful study of the habits—especially the breeding habits—of this fish. The sexes differ in colour; about three times as many males as females come to the spawning ground; the nests are built, mostly at night, by the males; each nest is the property of an individual male, who guards and defends it.

Spawning usually occurs at night; sexual excitation of the female is produced by the biting and rubbing of the male; the male may get two females to spawn in the same nest; the larvæ leave the nest in a swarm with the male and appear to follow him by scent. The larvæ are black until they are 30 to 40 mm. in length, and a school of black larvæ when separated from the male begins to circle and continues to do so as a whole or in fragments until re-united with the male. When about 30 to 40 mm. long the black larvæ begin to show orange and green colours. The schools of bright-coloured larvæ move more rapidly in the water, do not circle in search of the male, and are not closely guarded. Schools of larvæ of greater length than 100 mm. have not been observed; the schools probably disperse when the larvæ are about this size.

* Journ. Linn. Soc. (Zool.) xxix. (1904) pp. 188–217 (4 pls.)
† Mark Anniv. Vol., 1903, pp. 279–89 (1 pl.).
‡ Tom. cit., pp. 57–109 (1 pl. and 1 fig.).

New Cranial Nerve in Selachians.* — W. A. Locy returns to a nerve which he discovered in 1899, and gives fresh details as to its history. In arises in young embryos of *Squalus* and other Selachians on the dorsal summit of the forebrain on each side of the neuropore, in close connexion with elements of the disappearing neural crest. Its fibres are formed slightly before those of the olfactory nerve, and proceed to the olfactory epithelium. Pinkus has observed a similar nerve in *Protopterus*, and Allis in *Amia*. Even if it be one of the olfactory bundles in an unusual position, its separateness in origin and differences from all other olfactory radices would still justify the term "new nerve." It has been looked for in vain in amphibians and Teleosts.

History of the Eye of Amblyopsis.† — Carl H. Eigenmann discusses the whole story of the eyes of this blind fish. "In *Amblyopsis* which carries its young in its gill cavity, we are undoubtedly dealing with an animal in which the eyes are useless in the young as well as in the adult, and in which they became totally useless in the young at the same time that they became totally useless in the adult, that is, at the time when the species took up permanent quarters in the caves. Do the eyes in this case repeat the phylogenic history of the eye, or have the eyes in the embryo degenerated in proportion to their degeneration in the adult? The question is whether a perfect or better eye is produced to be finally metamorphosed into the condition found in the adult, or whether the development of the eye is direct."

Eigenmann's results show that the foundations of the eye are normally laid in the embryo, but that the superstructure, instead of continuing the plan with new material, completes it out of the material provided for the foundations, and that, in fact, not even all of this (lens material enters into the structure of the adult eye. "The development of the foundations of the eye are phylogenic, the stages beyond the foundations are direct."

Segmental Veins in Amphioxus.‡—Boris Zarnik refers to Burchardt's discovery (1900) of the ductus Cuvieri in the lancelet, and points out that behind this there are several variable vessels, which display metameric arrangement. These are transverse segmental veins, and the ductus Cuvieri may be regarded as a specialisation of one of these. They are very variable, and must be regarded as rudimentary structures. In this respect, as in many others, *Amphioxus* is intermediate between the Craniota and the Annelids. The author gives an account of the general circulatory system of the lancelet.

Experiments on Ciliary Movements.§—L. Launoy finds that the local application of a solution of chlorhydrate of amylein has a tonic action upon the vibratile cilia of the pharyngeal membrane of the frog. It is, however, temporary, and is succeeded by an adynamic state.

* Mark Anniv. Vol., 1903, pp. 39–55 (2 pls.).
† Tom. cit., pp. 167–204 (4 pls.).
‡ Anat. Anzeig., xxiv. (1904) pp. 609–30 (1 pl. and 7 figs.)
§ Comptes Rendus, cxxxix. (1904) pp. 162–5.

Adipogenic Function in Vertebrates and in Crustacea.* — C. Deflandre finds that in *Astacus* there is abundance of adipo-hepatic reserves in March, April and May, it is lessened by October and November, and absent from December to February. There are seasonal variations also in crabs. In *Amphioxus* the hepatic function of the cæcum is indicated by the green coloration of its walls and the presence of fine fatty granules in the cells. In fishes the function is greatly developed, but is seasonal. In the carp fatty reserves are stored increasingly from February to April; from this time they decrease, and are exhausted in December. In reptiles there is but slight development of this function. In land birds it is not usual, save in cases of overfeeding and at the breeding season. Aquatic birds are always rich in fatty material.

Microscopic Fresh-water Animals from Asia Minor.†—Eugen von Daday gives an annotated list of forty-three small fresh-water animals from Asia Minor, including *Mastigocerca heterostyla* sp. n., *Pedalion mirum*, *Onychocamptus heteropus* g. et sp. n., and *Limnicythera dubiosa* sp. n. Seven forms in his list are known only from Asia Minor.

Fresh-water Micro-fauna of Turkestan.‡—E. v. Daday gives a very full account of the Protozoa, Cœlentera, Nematohelminthes, Rotifera, Entomostraca, etc., of this region. Cosmopolitan forms, he finds, occur in greatest numbers, though many of these have not yet been observed in other Asiatic regions. It may reasonably be maintained that the micro-fauna of Turkestan is a duplicate of the European.

Tunicata.

New Type of Ascidian.§ —W. E. Ritter discusses the structure of *Herdmania claviformis* g. et sp. n., from the coast of California—a unique type requiring a family for itself (Herdmaniidæ). The colony is composed of crowded but entirely free zooids, arising by budding from short, much-branched, closely interwoven stolons. The body of the zooid is large, long and narrow, consisting of three regions—thoracic, digestive, and cardiogenital. There is a peculiar grouping of the numerous branchial tentacles. The oviduct serves as a uterus, in which the embryos go through their development to nearly the period of metamorphosis. Quite unique is the presence of two epicardiac tubes, separate throughout their length. The new type seems to be a divergent offshoot from the Polyclinid branch.

Æstivation of Botrylloides gascoi.‖—Frank W. Bancroft studied at Naples the hitherto unobserved partial dying-down of the compound Ascidian *Botrylloides gascoi*. In a colony kept in an aquarium a yellow lobe containing no zooids was developed; later on all the zooids degenerated, and finally all the colony, except the yellow lobe, died. The

* Journ. de l'Anat. et Phys., xl. (1904) pp. 305–36.
† SB. Akad. Wiss. Wien, cxii. (1903) pp. 139–67 (2 pls.).
‡ Zool. Jahrb., xix. (1904) pp. 469–553 (4 pls.).
§ Mark Anniv. Vol., 1903, pp. 237–61 (2 pls.).
‖ Tom. cit., pp. 147–66 (1 pl.).

ampullæ kept up a circulation in the isolated lobe for about two weeks, after which buds re-appeared in it. An examination of half the colony showed that there were small isolated buds, probably produced by the zooids which had degenerated, scattered all through the colony. The colony gradually recovered its former condition, except that it always retained its yellow colour, which is characteristic of *Botrylloides luteum* von Drasche. Therefore this species is a seasonal variation of *B. gascoi*. During rejuvenescence the colony differed from the normal colony in various ways, which are particularly described. The cause of these deviations from the normal seems to be the inadequacy of the food supply. This case of æstivation is in general similar to the hibernation described in various Ascidians.

INVERTEBRATA.

Mollusca.

Scientific Value of Conchology.*—O. Boettger supports the claims of the study of molluscan shells. He speaks of the problem of their coloration, suggesting that the pigmentation (often hidden more or less completely from sight) is an organised way of dealing with guanin-like waste-products. He refers to the modifications of shell-form in different localities and conditions, to the varied protective values of the shell, to phenomena of variation and convergence, and so on. The study of shells is rich in data of biological interest.

γ. Gastropoda.

Spermatozoon of Helix pomatia.†—A. Bolles Lee has made a detailed study of this spermatozoon. The head consists of two portions, an *exosome* and an *endosome*, the former partially enveloping the latter, and containing all the nuclein. The tail or body consists of an axis cylinder and a tubular membrane, the *exolemma* surrounding it. Platner's spiral fibre is an illusion.

The axis cylinder consists of two fibres wound together and imbedded in a granular substance, the whole being enveloped in a structureless membrane, the *endolemma*. The exolemma is not cytoplasmic, it is a delicate membrane provided internally with a spiral thickening.

The neck is an articulation, adapted to allow the ready separation of the head. Neither in the neck nor elsewhere is there any centrosome, and there is no distinct *Mittelstück* or "segment moyen," such as is seen in Urodela.

Notes on the Pleurotomidæ.‡—Thomas L. Casey discusses this large family, basing his study on a review of over 600 species, living and fossil. He discusses the vexed question of genera, and compromises by dividing the family into eight more or less definitely limited and definable "tribal groups," and regarding most of the subdivisions under these tribal headings as true genera until their values can be determined more accurately.

* Ber. Senckenberg. Nat. Ges., 1903, pp. 177-86.
† La Cellule, xxi. (1904) pp. 79-117 (1 pl.).
‡ Trans. Acad. Sci. St. Louis, xiv. (1904) pp. 123-70.

Spire Variation in Pyramidula alternata.*—F. C. Baker has tried to ascertain the amount of variation in the spire of this species from several localities. One of the most noticeable features in the curves submitted is their tendency to assume a multimodal form, which is indicative of great variability. The Western specimens have a higher shell, on the average, than the Eastern forms, and a much larger amount of variation in spire elevation.

Tidal Synchronism of Littoral Animals.†—G. Bohn gives the results of observations on *Littorina* and other shore animals. The periwinkle has two ways of orientating itself, one corresponding to the period of maximum wetness, and the other to maximum dryness. This may be seen on other shore animals, and the duration and extent vary according to the habitat, whether supra-littoral zone (e.g. *L. rudis*) or lower down. The habit is persisted in, even in aquaria, where a shadow may produce the effect. The animal takes its bearings in relation to a certain direction, which the author terms the line of luminous force. In other words, it is due to a light effect on more or less hydrated protoplasm.

Effect of Temperature on Growth in Physa taslei.‡—M. H. Rajat finds that in a brook at Saint-Clair near Lyon, there is a difference of 5° C. between the temperatures at its source and at its junction with the Rhone. In it *Physa taslei* is abundant; in the region of the lower temperature they are larger both in length and diameter, and in the Rhone itself, they are two-thirds larger than those at the source of the brook.

δ. Lamellibranchiata.

Variations in Pecten.§—C. B. Davenport makes a comparison of Pectens from the east and the west coasts of the United States. He procured a large collection of Pectens from Dunedin, on the Gulf Coast, 15 miles west of Tampa, Florida (*Pecten gibbus* var. *dislocatus*); and he obtained another collection from San Diego, California (*Pecten ventricosus*). The Tampa and San Diego Pectens appear to be closely related, and environmental factors being the same, the variability should be the same. Any considerable difference of variability is probably due to a difference in the action of the environment. It turns out that in all proportions measured, the San Diego Pectens show themselves from 50 p.c. to 100 p.c. more variable than those of Tampa. The conclusion arrived at is that the greater variability of the individuals from San Diego is due to the more varied present environment, which tends to make some shells deviate in one way and others in another, and to the past rapid changes in the physiographical conditions which have favoured the more responsive, adjustable individuals, and so have given rise to a race of which the individuals are easily modified by the diverse environments offered. The geographic history has given San

* Amer. Nat., xxxviii. (1904) pp. 661–8 (4 figs.).
† Comptes Rendus, cxxxix. (1904) pp. 646–8.
‡ Ann. Soc. Linn, Lyon, l. (1904) pp. 131–3.
§ Mark Anniv. Vol., 1903, pp. 121–36 (1 pl.).

Diego a plastic race; the diversity of the present environments of San Diego has determined the excessive variability of that race.

Eye of Pecten irradians.*—Ida H. Hyde finds that the nerve distribution in this eye has been in several respects misunderstood. The rods have been inadequately described; the "retinophoræ" are not the visual sensory cells whose peripheral fibres form the basal optic nerve, but are the supporting cells of the median layer of the retina; the inner ganglionic cells do not connect with the side branch of the optic nerve, but are the nerve-cells of the bipolar nerve elements; the outer ganglionic cells form a single layer, whose inner fibres are disposed in a special reticular structure in the retina, and whose outer fibres make direct connection with the side branch of the optic nerve; the existence of the large marginal ganglionic cells and their relations to the bipolar and optic nerve were not known to other investigators of the eye of *Pecten*; the visual apparatus of the retina is composed of afferent and efferent neurons, and the rods are true peripheral visual neurons.

Arthropoda.

a. Insecta.

Phototropism of Vanessa antiopa.†—G. H. Parker has made an interesting study of the behaviour of the mourning-cloak butterfly in relation to light. In bright sunlight the insect comes to rest with the head away from the source of light, when the surface on which it settles is not perpendicular or very nearly perpendicular to the direction of the sun's rays. Otherwise, it settles without reference to the direction of the rays. This negative phototropism is seen only in intense sunlight and after the butterfly has been on the wing, i.e. after a certain state of metabolism has been established; for *V. antiopa* creeps and flies toward a source of light, that is, it is positively phototropic in its locomotor responses. Both negative and positive phototropism in this species is independent of the "heat-rays" of sunlight.

The position assumed in negative phototropism exposes the colour patterns of the wings to fullest illumination, and probably has to do with bringing the sexes together during the breeding season.

When both eyes are painted black all phototropic responses cease and the insect flies upward. Butterflies with normal eyes, liberated in a perfectly dark room, come to rest near the ceiling. This upward flight in both cases is due to negative geotropism, not to phototropic activity.

The butterfly remains in flight near the ground because it reacts positively to large patches of bright sunlight rather than to small ones, even though the latter, as in the case of the sun, may be much more intense. Its retreat at night and emergence in the morning are mainly due to temperature changes.

Influence of Low Temperatures on Pupæ.‡—E. Krodel subjected pupæ of *Lycæna corydon* and *L. damon* to extreme cold (−14° R.).

* Mark Anniv. Vol., 1903, pp. 471–82 (1 pl.).

† Tom. cit., pp. 453–69 (1 pl.).

‡ Allg. Zeitschr. Entom., ix. (1904) pp. 49–55, 103–10, 134–7 (21 figs.). See Zool. Zentralbl., xi. (1904) pp. 493–4.

Pupæ were taken 5 to 6 hours after pupation, and subjected three times a day for six consecutive days to half-hour periods of cold. The results were aberrations exactly like the natural aberrations, e.g. in the occasional absence of the eye-marking on the under sides of the wings. The upper surfaces were not affected.

Pigment of Silk of Antheræa yana-mai.*—J. Villard states that the green colour of the silk of this insect is not chlorophyll as had been alleged. In common with the latter, its spectrum has a band of absorption in the red, which, however, is given by a blue element which can be extracted by boiling alcohol.

Metamorphosis of Insect Larvæ.†—J. Dewitz reports on many new experiments which he has made confirmatory of his thesis, that in the colour-changes and form-changes associated with metamorphosis an enzyme in the vascular fluids plays a very important role.

Regeneration of the Anterior End of the Body in Pupæ of Lepidoptera.‡—Jan Hirschler has made some remarkable experiments with pupæ of *Thais polyxena*, *Bombyx lanestris*, *Saturnia pavonia*, and *Samia promethea*. He removed the head, neck, and the most anterior part of the thorax. Much of the content of the pupa flowed out, and this was covered with melted paraffin, so that the wound was closed to the outer world.

The wound closed itself from within by an accumulation of finely granular debris of fatty, muscular, and other elements. A second protection, a special scar-tissue, was thereafter formed, mainly from the epithelial layer of the tracheæ. Thirdly, the hypodermis grew round to the centre of the wound.

Thereafter the hypodermis formed by an evagination, a sensory organ in the form of a papilla or club, or fork or rosette.

The gut and the glands remained blind ; no stomodæum was formed, nor any brain. The first of the remaining ganglia sent branches into the new structure. There was abundant regeneration of muscle. Noteworthy, throughout, was the almost complete absence of mitotic division.

Two New Cave-Beetles.§—J. Müller describes *Apholeuonus pubescens* and *A. taxi*, two new species from Dalmatian caves. They stand somewhat apart from the previously reported *A. nudus* described by Apfelbeck, and the author thinks they require a sub-genus, which he calls *Haplotropidius*.

Antennary Sense-Organs of Tryxalis nasuta.‖—Ernst Röhler finds that the large broad antennæ of this Orthopteron have very numerous sensory structures, etc. There are sensory cones lying in pits (Schenck's *sensilla cœloconica*), and short hairs projecting on the surface (Schenck's *sensilla basiconica*). There are also long pointed setæ whose sensory character was not demonstrated. The peculiar broadening of the antennæ affords room for the many hundreds of sensory structures, and the male has far more than the female.

* Comptes Rendus, cxxxix. (1904) pp. 165–6.
† Zool. Anzeig., xxviii (1904) pp. 166–82.
‡ Anat. Anzeig., xxv. (1904) pp 417–35 (5 figs.).
§ SB. Akad. wiss. Wien, cxii. (1903) pp. 77–90 (1 pl. and 4 figs.).
‖ Zool. Anzeig., xxviii. (1904) pp. 188–92 (4 figs.).

Nerve-Cells of Cockroach.*—Rolfe Floyd has used various methods in studying the nerve-cells in the thoracic ganglia of *Periplaneta orientalis*, and finds that they possess no evident cell-walls, that their nuclei, though exhibiting a reticulum, with enlarged nodal points and irregular amorphous deposits, after most fixing reagents, are homogeneous in appearance in the fresh condition, and after fixation in formalin vapour. They contain nucleoli and an entire nuclear membrane; the cytoplasm contains a fine anastomosing reticulum, whose interstices show no structure or staining affinities in the fresh condition. There are, however, one or more substances, presumably existing in the cytolymph in the normal living cell, that may change in character and form deposits upon the cyto-reticulum under the influence of fixing reagents, post-mortem changes, arsenical poisoning, etc. The deposit, or rather the material from which it is derived, is reduced by prolonged nervous activity; it in some way represents the potential energy of the cell; it seems to correspond with the chromophilic substance of the nerve-cells of higher animals.

Australian Thysanoptera.†—W. W. Froggatt explains that the three species of *Idolothrips* described by Halliday, viz. *I. spectrum*, *I. marginata*, and *I. lacertina*, are the two sexes, and a smaller and more variable form of the male, all of the same species. The characters of egg, larva (several stages), pupa and imago are given, together with notes on habits of this form, *I. spectrum*.

Entomological Notes.‡—N. Cholodkovsky gives an account of the histology of the yellow spots and the knob-shaped hairs of the caterpillar of *Acronycta alni*. Each hair is connected with two cells, one of which, the trichogen, is plainly glandular in character. Notes are also given on the dark blue neck-stripes of the caterpillar of *Gastropacha pini*, and on the wax-making glands of *Chermes*.

Stridulation in Ranatra fusca.§—J. R. De La Torre Bueno has repeatedly observed that this member of the Hemiptera cryptocerata produces a chirping noise when taken out of the water. This is due to the movement of the anterior coxæ in the deep and elongated joint-surfaces on the lower surface of the prothorax.

Classification of Hexapoda.‖—A. Handlirsch proposes a new classification of the Insecta, claiming that the groups proposed are not artificial and arbitrary, based on external similarity, but phylogenetic concepts. Thus his sub-classes are not co-extensive with the old Orders. The following are his Classes:—

I. Collembola (Lubbock), 2 Orders.
II. Campodeoidea (= Archinsecta Haeckel), 2 Orders.
III. Thysanura (Latr.), 2 Orders.
IV. Pterygogenea (Brauer), 11 Sub-classes, embracing 28 Orders.

* Mark Anniv. Vol., 1903, pp. 339-58 (4 pls.).
† Proc. Linn. Soc. New South Wales (1904) pp. 54-7 (1 pl.).
‡ Zool. Jahrb., xix. (1904) pp. 554-60 (1 pl.).
§ Canad. Entomol., xxxv. (1903) pp. 235-7. See Zool. Zentralbl. xi. (1904) p. 592.
‖ Zool. Anzeig., xxvii. (1904) pp. 733-59.

Genital Apparatus of Trichoptera.*—H. Stitz supplements the work of Zander on the male genital organs of Trichoptera in a few points, and reviews the conditions in the female of *Limnophilus bipunctatus*, *Phryganea striata*, and *Molanna angustata*. From these he concludes that all the parts of the female genital apparatus of the Microlepidoptera are found in the Trichoptera, but in other positions and variously modified. The Trichoptera in the structure of these organs approach the Neuroptera.

Studies on Lice.†—Günther Enderlein gives a description of the external structure of lice. He shows that the Anoplura must remain as one of the five sub-orders of Rhynchota. Four families are recognised—Pediculidæ, Hæmatopinidæ, Echinophthiriidæ, and Hæmatomyzidæ. An analytic key to the families, sub-families, and genera is supplied, and four new genera are described. Finally, the author has some remarks to make on the systematic arrangement of the orders of Insecta.

Dermatobia hominis.‡—H. B. Ward gives a full account of the structure, development, and distribution of the larva of this œstrid or bot-fly, which sometimes occurs as a parasite in man. It occurs commonly in the skin of cattle, pigs, and dogs, less frequently in man, rarely in the mule. It is also recorded from agouti, jaguar, various monkeys, the toucan, and an ant-thrush. In some regions it is a veritable plague to cattle. Its presence in man is accompanied with excruciating pains, especially at times when the larva is moving. In no case on record has the adult been developed from any larva taken from human flesh. It occurs in Brazil, Colombia, Mexico, Costa Rica, approaching close to the borders of the United States.

δ. Arachnida.

Structure and Classification of Arachnida.§—E. Ray Lankester gives a reprint of his article on the Arachnida from the tenth edition of the 'Encyclopædia Britannica.'

Tick Fever in Uganda.‖—P. H. Ross and A. D. Milne give some notes on fever cases due to tick-bite, which seems to transfer a spirillum to the blood. The tick has been identified by F. V. Theobald as *Ornithodorus savignyi* (Audouin) var. *cæca* Neumann, supposed by some to be the same as *Argas moubata* (Murray). Their habitat is in the old and dirty thatch of native huts, in cracks of mud walls and floors, in which they hide during the day, coming out to feed at night.

Oribatid Mites from the Neighbourhood of Cambridge.¶—C. Warburton and N. D. F. Pearce give a list and note that in four winter months specimens of forty-seven out of the hundred known British species were taken in the neighbourhood of Cambridge, and that every one of the fifteen British genera is locally represented.

* Zool. Jahrb., xx. (1904) pp. 277–314 (3 pls.).
† Zool. Anzeig., xxviii. (1904) pp. 121–47 (15 figs.).
‡ Mark Anniv. Vol., 1903, pp. 483–513 (2 pls.).
§ Quart. Journ. Micr. Sci., xlviii. (1904) pp. 165–269.
‖ Brit. Med. Journ. (1904) pp. 1453–4.
¶ Proc. Cambridge Phil. Soc., xii. (1904) pp. 427–9.

ε. Crustacea.

Spermatozoa of Crayfish.*—E. A. Andrews gives a clear and admirably illustrated account of the remarkable spermatozoa of *Cambarus affinis*. He describes the well-known "vesicle" which takes up about one half of the bulk of the sperm. It is set in the body of the sperm somewhat as a very small inverted cup might be held in the hollow of one's closed hand. This vesicle is evidently a new formation that comes to lie in the cup-shaped nucleus. It is inferred that the nucleus becomes like a hollowed hand holding the vesicle like an inverted bowl on the palm, and enveloping all but the bottom of the bowl by long, spirally coiled prolongations of the palm, the 4 to 7 "arms" of the sperm.

Study of the spiral uncoiling of the "arms" shows that there are at least two kinds of sperm among spermatozoa from the same male. Some show the arms unwinding from right to left and others from left to right. The author has some remarks on the spermatozoa of *Astacus*. He notes finally that the form of the sperm at any stage seems dependent upon osmotic pressure.

Phagocytic Cells in Amphipods.†—L. Bruntz finds that in *Gammarus pulex* and *Talitrus locusta* there are three kinds of phagocytes, viz. pericardial nephrocytes, cells of the hepatic artery capillary net, and young blood-cells which are mechanically arrested in the adipose tissue. These last are the "little cells" of the fatty tissue described by Kowalevsky.

Distribution of Niphargus.‡—W. F. de Vismes Kane reports the occurrence of the blind *Niphargus kochianus* Bate in the open waters of Lough Mask. It may have come from subterranean channels and reservoirs which communicate with the lough. The author also reports the occurrence of *N. subterraneus* Leach from five out of eight wells examined in the vicinity of Lynsted in Kent.

Development of Sacculina.§—P. Abric gives some interesting facts regarding the early development of this form. The division of the vitellus is total at first, and the egg is divided into two parts. The second plane is perpendicular to the first, and up to stage six the segmentation is symmetrical. After this, however, in a very large proportion of cases there are irregularities of segmentation, dependent on two causes: (1) cells which in a normal case arise in pairs of the same age do not arise at the same time, so that an uneven number results; (2) precocious division of cells may occur before the preceding pair have reached equilibrium, thus establishing irregular equilibrium. It is an interesting illustration of the indetermination of blastomeres, since whatever the mode of segmentation, all the eggs give rise to nauplii.

Fresh- and Brackish-water Crustacea of East Norfolk.‖—Robert Gurney gives an annotated list of the Crustaceans, except Ostracods, of the Broads district. He has, *inter alia*, notes on the seasonal distri-

* Anat. Anzeig., xxv. (1904) pp. 456–63 (7 figs.).
† Comptes Rendus, cxxxix. (1904) pp. 368–70.
‡ Ann. Nat. Hist., xiv. (1904) pp. 274–83 (1 pl.).
§ Comptes Rendus, cxxxix. (1904) pp. 430–2.
‖ Trans. Norfolk and Norwich Nat. Soc., vii. (1904) pp. 637–60.

bution of Cladocera. The species increase rapidly in number from February onwards, and reach a maximum in September. The number is maintained in October, which is the time of the maximum sexual activity, but suddenly decreases thereafter.

Reactions of Daphnia pulex to Light and Heat.*—R. M. Yerkes finds that this water-flea is strongly positively phototactic to all intensities from 0 to 100 candle-power. There is no evidence of preference for a certain intensity. The heat accompanying the light from a 16 candle-power incandescent lamp does not seem to have any influence upon the direction or rate of movement.

Heat in the absence of light has a directive influence upon the movements; the animal is negatively thermotactic at a temperature of about 28° C. In a trough containing water of 28° C. at one end and 25° at the other, the animals migrated towards the region of lowest temperature. The fact that in the case of *Daphnia* phototactic reactions cannot be changed from positive to negative or the reverse by changes in temperature, indicates that light does not act upon the organism in the same way as heat does.

Unpaired Eye and Frontal Organ of Branchiopods.†—N. von Zograf takes a comparative survey of the structure and development of these organs in various Branchiopods. The median eye, especially in its central vesicle, is a very ancient structure with great uniformity of development. The frontal organs are primitive retrogressive structures, which probably formed originally a peripheral sensory apparatus. The "Nackenorgan" has no phylogenetic significance: it is a typical gland, probably assisting adhesion. Zograf concludes that the median eye and the frontal organs were possessed by the Prot-Arthropods, and thence transferred to Crustacea and Gigantostraca.

New Pycnogonid from the South Polar Regions.‡—T. V. Hodgson describes *Pentanymphon antarcticum* g. et sp. n., secured by the 'Discovery' during her stay in winter-quarters in McMurdo Bay. It seems to be fairly common. The only feature of importance which separates it from the genus *Nymphon* is the presence of a fifth pair of legs, a character which separates it from all Pycnogonids hitherto known. It is noted that the Scottish Antarctic Expedition obtained several specimens of a ten-legged Pycnogonid from the Weddell Sea, which may prove to be identical with this species.

Annulata.

Tube-formation in Annelids.§—H. R. Linville, in an interesting paper, gives an account of the habits of *Amphitrite ornata* and *Diopatra cuprea*, with especial reference to the formation of the tubes. The consideration of minute adaptations of structure to function is the point of the paper.

* Mark Anniv. Vol., 1903, pp. 359-77.
† Das unpaare Auge, die Frontal organe und das Nackenorgan einiger Branchiopoden. 4to. Berlin (1904) 44 pp., 3 pls. and 3 figs. See Zool. Zentralbl., xi. (1904) pp. 729-34.
‡ Ann. Nat. Hist., xiv. (1904) pp. 458-62 (1 pl.).
§ Mark Anniv. Vol., 1903, pp. 225-35.

Fresh-water Nereids.*—H. P. Johnston gives an account of three undescribed species of fresh-water Polychæta, all belonging to the family Nereidæ. All three species live in perfectly fresh (drinkable) water—*Nereis lemnicola* sp. n., from Lake Merced (invaded by salt water in late Quaternary times, but now part of the water system by which San Francisco is supplied); *Lycastis hawaiiensis* sp. n., from a spring near Honolulu; and *Lycastoides alticola* g. et. sp. n., from the Sierra Laguna, Lower California, an elevated habitat.

The possibility of a marine animal establishing itself in fresh-water is determined by four essential factors, two of which are intrinsic and two extrinsic:—

1. The possession of *euryhalinism*, i.e., the power of enduring considerable alterations in the salinity and specific gravity of the medium.
2. The presence of a suitable fresh-water habitat, accessible from the sea, with intermediate brackish-water areas.
3. The possibility of obtaining food in the new habitat.
4. The capability of breeding in the new environment.

Genital Ducts in Oligochæta.†—W. B. Benham describes a new species, *Haplotaxis heterogyne*, which is provided with only a single pair of ovaries and oviducts, and whose sperm-ducts and nephridia appear to be structurally almost identical. While the sperm-funnel is anatomically quite different from the nephridial funnel of the neighbouring segments, the sperm-duct is practically indistinguishable from a nephridial tube, and it originates from the funnel at the extreme ventral margin, in the position in which a nephridial funnel, if it were present, would lie. In other words, the duct does not issue from the centre of the funnel as in the sperm-ducts of other Oligochæta. It is suggested that here is a composite organ, such as Goodrich has described in several Polychæta, and termed by Lankester "nephromixium." It would appear that the sperm-ducts are not absolutely homologous throughout the Oligochæta.

New Species of Genus Phreodrilus.‡—W. B. Benham describes three new species of this genus of Oligochæta from New Zealand. Their characters are such as to support the view of Michaelsen, who includes in this genus the Hesperodrili of Beddard.

Urns of Sipunculus nudus.§—F. Ladreyt finds that these "organites" arise from the connective tissue of Poli's tubes and the covering endothelium. They are not phagocytes, for no part of the material collected by their cilia is to be found within the urn. It is thrown into the cœlome. Their morphology and physiology exclude the hypothesis that they are Protozoan or Mesozoan parasites.

Embryonic Envelope of Sipunculids.‖—J. H. Gerould seeks to show that the *serosa* of *Sipunculus* represents the remains of a degenerating

* Mark Anniv. Vol., 1903, pp. 205–23 (2 pls.).
† Quart. Journ. Micr. Sci., xlviii. (1904) pp. 299–322 (3 pls.).
‡ Tom. cit., pp. 271–98 (3 pls.)
§ Comptes Rendus, cxxxix. (1904) pp. 370–1.
‖ Mark Anniv. Vol., 1903, pp. 437–52 (1 pl.).

prototroch equivalent to that of *Phascolosoma*. This in turn is homologous with the prototroch of mesotrochal Annelids, which clearly represents the most primitive conditions. The author compares the early development of *Sipunculus* and *Phascolosoma*, and suggests that the differences in the structure and fate of the prototroch in the two forms appear to be the immediate result of the presence or absence of yolk. Reasons are presented for believing that the ancestors of *Sipunculus* were provided with a yolk-laden prototroch, like that which *Phascolosoma* now presents.

Nematohelminthes.

New Nematode from Helix.*—A. Conte and A. Bonnet describe a new species, *Angiostoma helicis*, from the seminal vesicles and genital ducts of *Helix aspersa*. They found it in most of the specimens examined. The male is small and agile. The form is viviparous, and cannot live or reproduce except in the body of host.

Descriptions of Nemotodes and Cestodes.†—Von Linstow gives some notes on a number of parasites from a variety of hosts. There are two new species of *Filaria*, one of *Oxyuris*, and one of *Bothriomonus*.

Platyhelminthes.

New Cestode Genus.‡ — M. Kowalewski describes *Tatria beremis* g. et sp. n., from the intestine of a grebe (*Podiceps auritus*). It is a new representative of the sub-family Acoleinæ, and it is very different from *Acoleus*, which comes nearest to it. The proglottides have lateral appendages; the rostellum is armed on its apex with a crown of a few large hooks, and on its surface with many rings of little hooks. The genital organs are unpaired; the testes number about seven; there are two seminal vesicles; the male genital openings are regularly alternate; the receptaculum seminis is in the middle line of the proglottis; the external end of its vaginal canal enters into the next posterior proglottis, and joins there with the receptaculum seminis of this proglottis—thus forming a means for spermatozoa passing from one proglottis to another.

Abnormal Alimentary System in Opisthorchis felineus.§— Kurt Engler describes a variation in this Trematode. The gut is single for about a third of its length, and lies to the left side, then it divides into two forks to right and left. It seems as if the normal right half had been suppressed. Peculiarities in the position of other organs have followed as secondary results.

Australian Entozoa.‖—S. J. Johnston gives an account of five species of Holostomidæ, parasites of Australian birds, all of which are described as new.

* Ann. Soc. Linn. Lyon, l. (1903) pp. 63-8.
† Arch. für Naturgeschichte, i. (1904) p. 297-309 (1 pl.).
‡ Bull. Internat. Acad. Sci. Cracovie (1904) pp. 367-9 (2 pls.).
§ Zool. Anzeig., xxviii. (1904) pp. 186-8 (1 fig.).
‖ Proc. Linn. Soc. New South Wales, 1904, pp. 108-16 (3 pls.).

New Distomes.*—Henry S. Pratt institutes a new genus, *Renifer* (= *Styphlodera*), for small distomes from the mouth and air-passages of North American snakes and from the intestines of turtles. He describes three new species. From the frog he obtained a new genus, *Ostiolum*, with affinities with the genus *Hæmatolæchus* of Looss.

Incertæ Sedis.

New Enteropneustan Family.†—M. Caullery and F. Mesnil give a detailed account of a form of which they had previously given some notes under the name of *Balanocephalus kœhleri*. It appears, however, to be the representative of a new family, Protobalanidæ, whose characters are stated thus :—The cœlome preserves the embryonic arrangement of a cavity for the gland, a pair of cavities with mesentery for the collar, and another pair with equally persistent mesentery for the trunk. There are no lateral septa in the trunk, no perihæmal cavities, and no peripharyngeal cavities in the collar. Other characters are as in Harrimaniidæ. The type species is re-named *Protobalanus kœhleri*. Its dimensions are 4 to 6 cm. by 1 to 1·5 mm. wide. Habitat, Anse St. Martin, in the English Channel, in the littoral zone.

New Enteropneustan Species from Naples.‡—J. W. Spengel gives a description of the anatomy of the several regions of a new form, *Glossobalanus elongatus* sp. n., from the Gulf of Naples, including a discussion on the post-branchial gut of the Ptychoderidæ.

Young Stages of some Enteropneusta.§—W. E. Ritter and B. M. Dawis describe a Tornaria, possibly of *Balanoglossus occidentalis* Ritter, from the Californian coast. They pay particular attention to the habits and reactions. Another Tornaria (*T. hubbardi*) is described, which is equally noteworthy in having before metamorphosis five pairs of gill-sacs, though still without pore and tongue. The authors also note that *Dolichoglossus pussillus* Ritter has no Tornaria.

Bryozoa from Franz-Josef Land.‖—A. W. Waters gives an account of the Cyclostomata, Ctenostomata, and Endoprocta collected by the Jackson-Harmsworth expedition, 1896–97.

Echinoderma.

Revision of the Blastoids.¶—G. Hambach offers a re-classification based mainly on the construction of the summit openings. Next the development of the deltoids is considered, also the aspect of the outer surface. He recognises two orders : I. Regulares, including Pentremidæ (*Pentremites*, *Cribloblastus*, *Saccoblastus*, *Clavæblastus*, *Mesoblastus*, *Cidaroblastus*, *Globoblastus*, *Codonites*), and Codasteridæ (*Codaster*) ; II. Irregulares, including Olivanidæ (*Olivanites*) and Eleutheroblastidæ

* Mark Anniv. Vol., 1903, pp 23–38 (1 pl).
† Zool. Jahrb., xx. (1904) pp. 227–56.
‡ Tom. cit., pp. 315–62 (3 pls.).
§ Univ. California Publications: Zoology, i. (1904) pp. 171–210 (4 pls.).
‖ Journ. Linn Soc., xxix. (1904) pp. 161–84 (3 pls.).
¶ Trans. Acad. Sci. St. Louis, xiii. (1903) pp. 1–67 (6 pls.).

(*Eleutheroblastus*). Numerous new species are described from the author's very large collection.

Revision of Palæozoic Palæëchinoidea.* —Mary J. Klem lays emphasis on the amount of variation, e.g. in the different parts of the corona. "Deviations from the pentamerous arrangement are the rule rather than the exception." Many alleged new species are merely variations. The sub-class is divided into three orders: Cystocidaroida, Bothriocidaroida, and Perischoëchinoida. Twelve doubtful genera are left unclassified. A synopsis of all the known species is given, and the author has notes on the development of the test-plates individually and of the various areas of the test.

Cœlentera.

Reproduction and Variation in Sagartia luciæ.†—Gertrude Crotty Davenport gives a full account of her observations on this sea-anemone. Longitudinal division is very common, and may take place in a few hours. Basal fragmentation is probably common in nature. A piece cut off will produce a normal individual with tentacles in from four to seven days. By longitudinal division the stripes are apportioned to the two daughter individuals, 8–4, 5–7, 9–3, and so on. The individuals are always tending by means of regeneration in the direction of twelve stripes and forty-eight mesenteries. Triglyphic forms occur and are apt to possess more than twelve stripes. By division of the twelve-striped condition or by division before the twelve-striped condition is attained, the mass of individuals may fall short of twelve stripes.

Anatomy of Madreporaria.‡ —A. Heicke has investigated some points in the anatomy of *Rhodaræa lagrenæi* and *Cœloria sinensis*, both from Singapore. In the former the polyps are of the actinian type. On the tentacles are tactile sense-buds. The mesenteries of each polyp bear both types of sex-cells. The characters of the archenteron are analogous to those of the Alcyonaria, especially those of the more highly differentiated genera of the Alcyonacea. The development of the asexual yonng individuals is very similar to that of the polyp from the fertilised egg. In *C. sinensis* the directive mesenteries are absent, and the number of mesenteries present is not uniform. This is related to the irregular processes of division, which also interfere with the usual multiple-of-six arrangement.

Medusæ from the Devonian.§ — F. Kinkelin describes from the middle Devonian Orthoceras-beds near Laurenburg on the Lahn, a fossil Medusa, one of the Discomedusæ, referable to Walcott's genus *Brooksella*. He names it *Brooksella rhenana* sp. n., and signalises it as the first medusa from Devonian strata.

Antarctic Hydroids.‖—Elof Jäderholm makes a preliminary note on the collection made by the Swedish Antarctic expedition (1901–3).

* Trans. Acad. Sci. St. Louis, xiv. (1904) pp. 1–98 (6 pls.).
† Mark Anniv. Vol., 1903, pp. 137–46 (1 pl.).
‡ Arch. für Naturgeschichte, i. (1904) pp. 253–96 (1 pl.).
§ Ber. Senckenberg Nat. Ges., 1903, pp. 89–96 (1 pl.).
‖ Arch. Zool. Expér., iii. (1904) Notes et Revue, pp. i–xiv.

He gives diagnoses of seventeen new species of *Myriothela*, *Eudendrium*, *Halecium* (2), *Lafoëina*, *Campanularia* (2), *Obelia*, *Thyroscyphus*, *Sertularella* (3), *Selaginopsis* (2), *Schizotrichia* (2), and *Plumularia*.

New Leptomedusan.* —Seitaro Goto describes a new craspedote medusa, *Olindioides formosa* g. et sp. n., from Misaki, related closely to *Gonionema* and *Halicalyx*, more distantly to the fresh-water genera *Limnocodium* and *Limnocnida*, and differing from its nearest relative *Olindias mülleri* in many striking points, e.g. in having six radial canals instead of four. In the meantime the sub-family Olindiadæ must rest under the Eucopidæ among the Leptomedusæ.

Early Development of Eudendrium.†—C. Hargitt gives an account of the oogenesis and early development of *E. ramosum*, together with notes on two or three other species. The ova arise in these hydroids by differentiation of cells of the entoderm or of the ectoderm or of both. They appear in the region of the hydranth or lower in the cœnosarc of the stem. No evidence as to the process of fertilisation was found. Further, in maturation no trace of polar cells could with certainty be recognised. The nucleus disappears, probably by fragmentation and gradual dissolution. Later it shows but slight trace of chromatin granules, and subsequently becomes more transparent, completely losing its chromophilous properties. After fertilisation its early reorganisation into one or more nuclear centres constitutes the initial impulse of development. With the massing of deutoplasm in the centre of the egg the cytoplasm is forced into a peripheral layer. Nuclear activity, slightly involving the cytoplasm, takes place; the deutoplasm divides into a series of yolk-balls within some of which bodies, suggestive of nuclei, are present. During the whole period the egg remains a syncytium. Especially in the earlier stages of this period the nuclei differ greatly both in size and shape. Nests of nuclei often showed evidences of having resulted from the amitotic division of a larger nucleus. Other evidences of amitosis were present. The paper contains also an account of the formation of ecto- and endoderm, and also the life-history of the planula.

Protozoa.

Physical Imitations of the Activities of Amœbæ.‡—H. S. Jennings reviews the experiments made by Bütschli, Rhumbler, and others. The imitations show that a drop of a certain emulsion may, through physical factors, exhibit locomotion, may move toward certain agents and away from others, and may exhibit "choice" in the taking in of certain substances and the rejection of others. But they *do not* show specifically through what physical factors the activities are, as a matter of fact, brought about in Amœbæ or in any similar organisms.

Few of the experimental imitations of the activities of Amœbæ stand before a critical comparison with what actually takes place in the living animal. Such comparison shows in almost every case that the

* Mark Anniv. Vol., 1903, pp. 1–92 (3 pls.).
† Zool. Jahrb., xx. pp. 257–73 (3 pls.).
‡ Amer. Nat., xxxviii. (1904) pp. 625–42.

factors at work in the imitations are essentially different from those acting in the Amœbæ. In particular, almost all the imitations based on local changes in surface-tension break down completely. The surface-tension theory is shorn of the trophies of its prowess—its supposed full explanation of most of the activities of Amœbæ—and bears instead the record of a complete defeat.

British Fresh-water Rhizopods.*—J. Cash describes a number of new and little-known forms, from Cheshire and Epping Forest. Testaceous forms occur in considerable abundance in wet *Sphagnum*, and amongst the rootlets of such mosses as *Philanotis fontana* and *Aulacomnium palustre*. The genera represented are *Difflugia*, *Nebela*, *Hyalosphenia*, *Quadrula*; the Euglyphina occur also in great variety. A remarkable naked reticulate Rhizopod, *Penardia* g. n., is described.

Asymmetry and Spiral Swimming.†—H. S. Jennings discusses the unsymmetrical or spiral type of structure seen in Infusorians and in the Rattulidæ among Rotifers. It is characteristic of animals which swim in spirals, and is to be considered as an adaptation to the spiral course. The spiral course is the simplest device for permitting an organism to make progress in a given direction through the free water, without having the parts of the body elaborately adjusted so as to balance each other accurately. Not having such elaborate adjustment, small organisms would swim in circles, were it not for their revolution on the long axis of the body. This converts the circle into a spiral course, permitting progress to be made. In such spiral course the organism maintains its body in a definite relation to the axis of the spiral, the same surface always facing outward, the opposite surface facing the axis of the spiral. Many organisms which swim in this manner have the body structurally adapted to this movement, the form approximating in some degree to a segment of a spiral. In these unsymmetrical organisms moving in spirals, the method of reaction to most stimuli is closely correlated with the unsymmetrical form.

New Opalinid.‡—C. A. Kofoid describes the structure of *Protophyra ovicola* g. et sp. n., a new ciliate Infusorian, obviously an Opalinid, from the broad sac of *Littorina rudis*. Its single contractile vacuole, posterior to a spherical macronucleus, and the absence of special structures such as the hooks of internal rods of *Hoplitophrya*, stamp this new genus as one of the least specialised members of the Opalinidæ. There is a micronucleus, which is known to occur in but a single other species of the family, viz. *Anolophrya branchiarum*. The specialisation of the new genus lies in its fine ciliation, the marginal zone of cilia, and the adaptive form of the animal.

Trypanosomes in Anglo-Egyptian Soudan.§—A. Balfour gives some notes regarding the occurrence of trypanosomes in the blood of a donkey.

* Journ. Linn. Soc., (Zool.) xxix. (1904) pp. 218–25 (1 pl.).
† Mark Anniv. Vol., 1903, pp. 315–37 (10 figs.).
‡ Tom. cit., pp. 111–120 (1 pl.).
§ Brit. Med. Journ., 1904, pp. 1455–6.

The species is probably *T. brucei*. An account is also given of the discovery of similar parasites, not yet particularly identified, in cattle from Kodok.

Effect of Human and Ape Serum on Trypanosoma.*—A. Laveran finds that not only are Cynocephali immune to Trypanosomes, but their serum gives positive results when inoculated on infected rats and mice. The trypanosomes disappear from the blood under strong inoculation. Normal human serum has also a killing effect, in fact it is stronger against *T. evansi*, *T. brucei*, and *T. equinum* than ape's serum.

Hæmogregarine in Psammodromus algirus.†—H. Soulié describes a new species from the blood of this reptile. He found one individual in every three infected, but without injurious effect. When young the parasite is an elliptical body, little less than the nucleus of the red corpuscle; the adult is generally reniform. In rare instances it was found free in the plasma. This species he names *H. psammodromi*.

* Comptes Rendus, cxxxix. (1904) pp. 177–9.
† Tom. cit., pp. 371–3.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Nature of Colour in Plants.*—H. Kraemer gives an account of the behaviour of the colouring substances, extracted from very various plant organs, towards chemical reagents. The plastid colours were extracted by placing the fresh material in 95 p.c. alcohol, and allowing it to macerate in the dark for a day or two. For complete separation xylol and other solvents were subsequently used. The author gives a list of the plants examined, indicating the part used, the nature of the solvent, and the colour of the solution. He also gives a series of tables indicating the colour changes produced in the solution by the addition of various reagents, acid, alkaline and neutral. The pigment giving the yellow colour in roots, flowers and fruits the author calls chromophyl; it is contained in a chromoplastid which varies much in shape, and usually contains proteid substances. In the inner protected parts of leaf-buds there is a yellow principle which the author calls etiophyl, and which is contained in an organised body (etioplast), which does not seem to contain either starch or proteid. The blue, purple and red colour substances in flowers are dissolved in the cell-sap, and are usually distinguished from the plastid colours by being insoluble in ether, xylol, benzol, chloroform, carbon disulphide and similar solvents, but soluble in water or alcohol. Similar cell-sap colour substances are found in spring, and also in autumn, leaves. The author regards the chromoplastids of both flowers and fruits, as having the special function of manufacturing or storing nitrogenous food-materials, for the use of the developing embryo or seed, more especially as protein grains are usually found in them. The same applies to the chromoplasts in roots, e.g. carrot, where the proteids of the plastid are utilised by the plant of the second year. The cell-sap colours, like other unorganised cell-contents, such as alkaloids, volatile oils, etc., are regarded as incident to physiological activity, and of secondary importance in the attraction of insects for the fertilisation of the flower and dispersal of the seed.

Structure and Development.

Vegetative.

Arrangement of the Vascular Bundles in the Stem and Leaves of some Dicotyledons.†—A. Col gives a detailed account of his work on the course and arrangement of the vascular tissue in Dicotyledons.

* Proc. Amer. Phil. Soc., xliii. (1904) pp. 257-77.
† Ann. Sci. Nat. (Botany), ser. 8, xx. (1904) pp. 1-288 (40 figs. in text).

Primarily it comprises an investigation of the anomalies of the vascular system in Campanulaceæ as far as concerns the aerial organs. In the light of the general results obtained the author proceeds to a consideration of anomalous vascular structure in Dicotyledons in general. The following is a brief *résumé* of his conclusions. In most cases abnormal vascular tissues represent a part of the course of normal bundles. Plants showing these anomalies form a series in which the normal course of the bundles gets shorter and shorter, till finally it becomes an abnormal bundle. The number of plants having such bundles is very restricted. Leaf-trace bundles in their course through the stem always diminish in volume from above downwards, whether they are isolated or united sympodially. All, or nearly all the fibro-vascular formations of the stem supply appendicular organs. We must regard these formations and part of those of the main root, as formed by the bundles which descend from the foliar appendages of the stem (and flowers). Rapidity of growth modifies this theoretical process of differentiation, which does not affect older secondary formations.

Development of the Central Cylinder of Araceæ and Liliaceæ.* M. A. Chrysler comes to the following conclusions from the study of a number of examples from these two families. The members of both families have primitively a collateral tubular central cylinder, or ectophloic siphonostele, derived from a protostele and interrupted by gaps above the points of exit of the foliar traces. Through these gaps the external and internal phlœotermas communicate. The intrastelar parenchyma is to be regarded as having the same origin as the cortex, i.e. both cortex and medulla are parts of the fundamental or ground tissue. This primitive condition becomes altered: (1) by degeneration of either the internal phlœoterma, or both internal and external phlœotermas; or (2) by the assumption of a medullary course by some vascular strands with which leaf-traces are connected; hence the scattered arrangement of bundles is to be regarded as a cenogenetic character. The amphivasal concentric strands are not a palingenetic feature, for they are derived from collateral strands, and do not occur in the base of the seedling nor in the leaves of floral axes. Anatomical evidence favours the derivation of monocotyledons from dicotyledonous ancestors.

Structure of the Sieve-Tubes of Angiosperms.†—A. W. Hill finds that the sieve-plates on the end walls are pierced by relatively thick slime strings, each of which is enclosed by callus. In the sieve areas of the radial and tangential walls the slime strings are much smaller than in the transverse sieve-plates, and three to six strings are enclosed in one rod of callus. The author also finds numerous very short connecting threads between the sieve-tubes and the companion cells, which during winter may be covered with callus on the side towards the sieve-tube. Study of the development in the sieve areas shows that groups of fine threads occur in the pit membranes in the lateral walls of the youngest sieve-tubes. The threads are converted into slime, while the surrounding cellulose membrane becomes changed into callus, thus

* Bot. Gazette, xxxviii. (1904) pp. 161–84 (4 pls.).
† Rep. Brit. Assoc. Meeting Southport, 1903 (1904) p. 854.

forming the rod with its contained slime strings. In the transverse plates the action has gone further, and a single large slime string is developed within the callus rod.

Seedlings of Gesneriaceæ.* — K. Fritsch gives an account of the structure and anatomy of the seedlings of a number of genera of this family, including *Streptocarpus*, *Ramondia*, *Achimenes*, and others. The author has also made a comparative study of the seedling and the adult plant. In a more general section of the book he gives a review of the morphology of the genus *Streptocarpus*, and a comparison with other members of the group to which it belongs.

Fossil Sequoia.†—E. C. Jeffrey gives a description of the structure of the wood of a fossil Sequoia from the Auriferous Miocene Gravels of the Sierra Nevada mountains. While showing structural features which unite it with the living Sequoias, it has others which suggest the Abietineæ, such as the paucity of resin-cells present only on the outer face of the summer wood, the highly developed medullary rays, and the traumatic resin-canals running both in the horizontal and vertical planes. The fragment is described as a new species, *S. Penhallowii*, apparently most nearly allied to *S. gigantea*, of which it has the geographical distribution.

Reproductive.

Embryogeny of Ginkgo.‡ — H. L. Lyon gives an account of his detailed study of the embryogeny of this isolated gymnospermous type, The mass of tissue which fills the egg after free nuclear division is termed the protocorm. The cells in the micropylar two-thirds of this spherical structure divide little or not at all, but those at the antipodal end form a small-celled meristem, which passes over directly into the meristem of the blastema or metacormal bud. The blastema pushes into the endosperm as a broad blunt cylinder, the protocormal tissue being forced back through the neck of the archegonium. Two "growth-foci,"—stem and root—are organised very close together in the axis of the metacormal bud, and later the primordia of the two cotyledons in the marginal region of the broad apical meristem. Hence much of the original protocormal tissue is not involved in the organisation of the embryo,—this is described as a rudimentary suspensor. Usually there are two cotyledons, but three were quite common. The author also describes the anatomy of the embryo.

Physiology.

Nutrition and Growth.

Mycorhiza of Pines.§ — A. Möller has conducted a research on seedling pines of one and two years' growth. The latter part of the

* Die Keimpflanzen der Gesneriaceen. By Dr. Karl Fritsch. 8vo, iv. and 188 pp., 38 figs. in text. Fischer, Jena.

† Bot. Gazette, xxxviii. (1904) pp. 321–32 (2 pls.).

‡ Minn. Bot. Studies, iii. (1904) pp. 275–90 (14 pls.). See also Bot. Gazette, xxxviii. (1904) pp. 390–1.

§ Zeitschr. Forst. Jagdw. xxxv. (1903) pp. 257 and 321. See also Centralbl. Bakt., xi. (1903) pp. 348–50.

study was mainly occupied with an account of the root fungi. These were present on the roots of the one-year seedlings, the hyphæ filling the cells of the cortex, recognisable externally by the darkening of the rootlets and by a slight increase in thickness. This endotropic fungus was thrown off with the development of the periderm. The root then becomes enveloped with the ectotropic mycorhiza. The tips of the main roots are free from the fungus. The writer discusses the probable species of fungus that provides the mycorhiza. He does not think it can arise from Mucorini. He also deals with the subject of nitrogen assimilation by the plant.

In connection with the same subject, F. W. Neger * has reviewed Stahl's experiments with plants in sterilised ground—with regard to the competition for nitrogen that is supposed to be aided by the presence of mycorhiza. Stahl held that plants which were always independent of mycorhiza would grow better when no hyphæ were present to exhaust the nitrogen of the soil. Neger finds that the more successful growth in sterilised soil must have been due to favourable chemico-physical conditions, and not to the absence of fungus hyphæ.

Nutrition of Fungi by Carbohydrates.† — M. Nikolski gives a historic review of previous work on this subject, and then states the problems he tried to solve, viz. the behaviour of filamentous fungi with regard to carbohydrates as nutriment. He experimented with *Amylomyces*, and states his methods of culture and examination. A long list of experiments follows, and the general results are summed up. Maltose was assimilated with much rapidity. Glucose and saccharose came next, and a long way behind galactose, fructose and rafinose.

Inulin proved to be the best medium as regards nutrition. Various changes are due to the age of the fungus, and periodicity of growth is noted depending on the different carbohydrates.

The final portion of the work deals with the formation of nitrogenous substances by the fungus, which is correlated with its development. After the maximum of growth is reached, nitrogen formation ceases.

Artificial Parasitism.‡—G. J. Pierce has succeeded in growing a pea-plant on a plant of *Vicia Faba*. The radicles of young seedlings were inserted into holes cut into the stem of strong young bean-plants, and fixed in place by a mould of plaster of Paris. The pea-plants, though smaller in size than usual, blossomed and formed seeds capable of germination. Comparing the sizes and weights of the seeds with the sizes of the plants, the author found that the individual seeds were much less reduced in size and weight by the enforced semi-parasitism of the parents than were the vegetative parts. Seeds of plants grown in this artificial manner were successfully germinated in sphagnum moss and transferred to bean-plants. They formed healthy plants, but somewhat smaller than those of the previous season. There was no true union between the root of the pea and the tissue of the "host." The roots grew downward through nodes and internodes, but did not in any

* Naturw. Zeitschr. Land. und Forstw., i. (1903) p. 372. See also Centralbl. Bakt., xi. (1903) p. 350. † Centralbl. Bakt., xii. (1904) pp. 554-9, 656-75.
‡ Bot. Gazette, xxxviii. (1904) pp. 214-7.

case reach the level of the soil. They branched much less freely than normal soil roots.

Distribution of Essential Oil in an Annual Plant.*—E. Charabot and G. Laloue find that a gain in the amount of essential oil in the inflorescence is balanced by a loss in the green organs, and *vice versâ*. Their results suggest that the essence is first carried from the leaves to the flower, acting as a carrier for the carbohydrates which are to nourish that organ. After fertilisation, when the storage of carbohydrates is completed and the influx of nutriment into the flower ceases, the essential oil seems to return to the green organs. As regards distribution among the different plant-members, the authors find that the root contains no essential oil, the stem only a small amount, while the leaf and inflorescence are the richest.

Sense-organs of Plants.†—G. Haberlandt describes the various types of structure, bristles, hairs and papillæ which serve for the perception of mechanical stimulus, and also gives an account of the statolith theory, in which both he and Němec found an explanation of the sensitiveness of plants to the force of gravity. He also discusses his recent theory of the mechanism by which plants perceive the direction of incident light. The epidermal cells act as the sense-organs. When light strikes a leaf at right angles to the surface, it results from the plano-convex form of the epidermal cells, that the inner wall of each cell is illuminated more brightly in the centre than at the periphery. If the light strikes the leaf obliquely, the bright patches on the inner cell walls are no longer central. This change, it is suggested, constitutes a stimulus calling forth a curvature of the leaf-stalk by which the leaf is brought again to its normal position at right angles to the incident light; the leaf moves when the bright patch is not central, and comes to rest when each of its epidermal cells is centrally illuminated.

Appreciation of Depth in Rhizomatous Plants.‡—C. Raunklaer finds as the result of experiments with *Polygonatum multiflorum*, that when placed at a certain level in the soil the rhizome is transversely geotropic, while at every other depth its geotropism changes, so that it becomes more and more positively geotropic as we approach the surface, and more negatively geotropic at increasingly lower levels. Thus the rhizome responds to changes in the direction of its growth, so as to maintain itself at a definite depth which is favourable to its development. That which indicates to the plant the depth at which the rhizome is buried is the distance which separates it from the level at which the aerial shoot reaches the light.

Formation of Roots and Shoots in Cuttings.§—E. Küster describes experiments which suggest that the polarity shown in cuttings

* Comptes Rendus, cxxxix. (1904) pp. 928–9.
† Die Sinnesorgane der Pflanzen. By G. Haberlandt. 46 pp., Barth, Leipzig, 1904. See also Nature, lxxi. (1904) pp. 123–4.
‡ Oversigt k. Dansk. Vidensk. Selsk. Forhandl., 1904, pp. 329–49 (5 figs. in text).
§ Ber. Deutsch. Bot. Gesell., xxii. (1904) pp. 167–70 (1 pl.); Jahrb. wiss. Bot., xl. (1904) pp. 279–302 (4 figs.). See also Bot. Gazette, xxxviii. (1904) p. 390.

of roots and shoots is due to external conditions. Roots of dandelion, which under uniform conditions of moisture, form roots at the lower and shoots at the upper end, gave an opposite result when the upper end was placed in water the lower end projecting into the air; shoots then developed on the exposed end and none on that in the water. When cuttings of the stems of *Ribes aureum* were placed with their basal ends in water and their apical ends in moist air, roots were formed only on their apical ends. Similar results were obtained with *Salix vitellina*, showing a marked tendency for the roots to appear only where there is a sufficient supply of air. When cuttings were rotated horizontally, the centrifugal force acted as a check on development, the inhibition being in proportion to the force; thus, if the apical end describe the greater circle, the buds there are inhibited more than those at the opposite end. In this way the usual polarity may be reversed.

Animal Parasites and Floral Teratology.*—Marin Molliard considers that the virescence of the flower which is frequently met with in *Trifolium repens* is due to the presence of the larva of a *Rhynophora* (probably *Hylastinus obscurus*) which lives in the stem of the plant, in which it bores a long gallery. He found this larva in fifty virescent specimens collected in two localities near Paris, whereas it was absent from normal plants growing near. Similarly virescent individuals of *Trifolium pratense* contained the same insect. The larva forms the galleries especially in the pith, whence it penetrates between the vascular bundles to reach the cortical tissue. One result is that many of the wood-vessels become clogged by a gummy substance, which will obviously interfere with the circulation of the sap. Similar facts have been noted in other plants. Thus, in a specimen of *Melilotus arvensis* with strikingly virescent flowers, the author found a larva of one of the Curculionidæ, while neighbouring normal individuals showed no trace of the insect. The author suggests that the abnormal development of the flower is a traumatic action, resulting from a profound modification of the conditions of nutrition caused by the mining operations of the insect, which acts at some distance from the flower.

Colour Changes in Fungi and Bacteria.†—T. Milburn has experimented with *Hypocrea rufa*, *H. gelatinosa*, *Aspergillus niger*, and *Bacillus ruber-balticus*. He tested the influence of culture media, osmotic pressure, light, temperature, etc., on the development of the pigments. He finds that with increasing osmotic pressure pigment-formation in the conidia of *Hypocrea rufa* is white, and that conidial formation is retarded: that acid media induce the formation of green conidia; while in alkaline media yellow conidia are formed. Well nourished mycelium fails to produce conidia, while a supply of oxygen or lowered nutrition induces conidial formation. *Aspergillus niger* forms a yellow as well as a black pigment. It is sensitive to light, and from yellow becomes grey or black. *Bacillus ruber-balticus* is influenced by the nature of the culture media to produce violet or orange colorations.

* Comptes Rendus, cxxxix. (1904) pp. 930-2.
† Centralbl. Bakt., xiii. (1904) pp. 129-38; 257-76 (2 pls. and 6 figs.).

Influence of Radium on the Growth of Fungi.*—J. Dauphin found that growth was retarded by Becquerel rays in cultures of *Mortierella*, *Mucor*, *Piptocephalis*, and *Thamnidium*. Spores of *Mortierella* would not germinate in the neighbourhood of a radium tube, but germinated when radium was removed. Further, he observed that the growth of hyphæ is arrested and processes are formed on the filaments; the plasma withdraws from the influence of the rays; septation of the hyphæ takes place; and the fungus becomes encysted. On removal of the rays, normal growth recommences.

Germination of Moss-Spores and the Nutrition of their Protonemas in Artificial Media.†—P. Becquerel has made a series of experiments on the germination of the spores of *Atrichum* and *Hypnum*, and the development of the protonemas in sterilised mineral solutions. The spores began to germinate three months after sowing, and the results show that the protonemas from the point of view of their nutrition behave in the same way as the green algæ cultivated in similar media by M. Charpentier. Ten elements suffice for their nutrition, namely, nitrogen, in a mineral form, iron, sulphur, phosphorus, magnesium, carbon, oxygen, and hydrogen, and sometimes calcium or potassium. *Hypnum* is distinguished from *Atrichum* by the fact that it can apparently do without potassium altogether.

General.

Fossil Flora of the Culm Measures of Devon.‡—E. A. Newell Arber gives a list of determinations from the Bideford district of the plant remains from the carboniferous rocks which form part of the large area extending through the Western counties, and generally known as the Culm Measures. The list comprises thirty species, representing the groups Equisetales, Sphenophyllales, Cycadofilices, Filicales, Lycopodiales, and Cordaitales. It includes records new to Devonshire, and also the first British record of *Neuropteris Schlehani*, a frond of common occurrence in the Coal Measures of the Continent, and a leaf new to Britain which somewhat recalls Dawson's genus, *Megalopteris*, chiefly known from the Coal Measures of Canada and the United States. The author also discusses the age of the beds in question.

Patagonian Plants.§—A. B. Rendle gives an account of a collection by Hesketh Prichard, made on his expedition to the mountain forests of Western Patagonia in search of the *Mylodon*. The plants were collected at the western end of Lake Argentino, where the lake is broken into numerous fiords by the forest-clad foot-hills of the Andes. They represent in part a pampas flora, in part the flora of the open mountain slopes, and in part the mountain forest flora. Prichard was much impressed with the dense primæval forests occupying many thousands of square miles, and appearing from a distance to rim the

* Comptes Rendus, cxxxviii. (1904) pp. 154–6. See also Ann. Mycol., ii. (1904) p. 472. † Op. cit., cxxxix. (1904) pp. 745–7.
‡ Proc. Roy. Soc., lxxiv. (1904) pp. 95–9.
§ Journ. Bot., xlii. (1904) pp. 321–34, 367–78 (1 pl.).

slopes and spurs of the Cordillera with an impenetrable mass of blackness. The most common tree is the Antarctic beech, which is often draped with the long trailing shoots of the parasitic loranth, *Myzodendron*. The flora of this district comprises a number of characteristic Patagonian plants, to which may be added the new species found by Prichard, together with a Chilian or Andine, and a Southern, Fuegian and Antarctic element. There are also several familiar northern plants of arctic and alpine or temperate distribution, such as *Phleum alpinum*, *Poa pratensis*, *Potentilla anserina*, and *Sonchus asper*.

Philippine Plants.*—Elmer D. Merrill continues his study of the flora of these islands. The present pamphlet contains descriptions of a new *Freycinetia*, and several new Screw-Pines; one of the latter, *Pandanus luzonensis*, from the island of Luzon, is about 8 metres high. Also a new *Artocarpus* from the same island, reaching 30 metres in height, several new figs, a new *Dischidia*, and various other novelties in different orders. The author also gives a systematic account of the species of *Terminalia* (eleven in number) found in the islands.

Illustrations of German Orchids.†—The firm of Friedlander has issued in an attractive form a volume on the wild orchids of Germany. There are sixty coloured plates by Walter Müller, and accompanying descriptions by F. Kränzlin. The plates give excellent life-size representations of the plant, together with enlarged figures of the flower and its parts, the latter carefully drawn and showing well the details. The descriptions are intelligibly written, and reference is made to points of interest on pollination, distribution, variation, etc. As our British orchid flora is wholly continental, the book appeals almost equally to the British plant-lover, and is worth buying for the plates alone.

British and Irish Botanists.‡—The conclusion of the second supplement of this useful list by J. Britten and G. S. Boulger includes the years 1898–1902, and entries from Milne-Readhead to Thomas Young. Besides the names of those more or less concerned in the advancement of Botany, who have died in the stated interval, there are a few omissions from previous lists.

Notes on the Drawings for "English Botany."§—F. N. A. Garry has concluded his enumeration of the notes on the original drawings for Sowerby's "English Botany." These drawings, upwards of 2500 in number, including the Cryptogams, and the corresponding herbarium of British plants, many of which were used for the figures, were bought in 1859 by the Trustees of the British Museum; and three years later the drawings of the first four volumes of the 'Supplement.' The original work appeared in thirty-six volumes between the years 1790 and 1814; the descriptions were written by Sir James Edward Smith, and the

* New and Noteworthy Philippine Plants. II. Department of the Interior, Bureau of Government Laboratories. Manila (1904) 47 pp., 3 pls.

† Abbildungen der in Deutschland u. den angrenzenden gebieten vorkommenden Grundformen der Orchideen-Arten. By Walter Müller and F. Kränzlin. 60 plates, with text. Friedlander, Berlin, 1904.

‡ Journ. Bot., xlii. (1904) pp. 378-85.

§ Op. cit., xlii., xliii. (1903, 4) Supplement, p. 276.

coloured plates were drawn mainly by James Sowerby. Four complete volumes of a supplement, and part of a fifth, were published between 1831 and 1865, with illustrations by J. De Carle Sowerby, James Sowerby's eldest son, partly in collaboration with J. W. Salter, with descriptions by various botanists.

The drawings are in nearly every instance annotated by the artist and by the writer of the descriptions, and the author has transcribed all such notes as are of any value or interest with regard to the drawings or the specimens figured. He has also carefully collated the specimens in Sowerby's herbarium. It is of interest to note that forty-eight of the plants figured were collected in Battersea Fields, and thirty-three in other London localities, such as St. George's Fields, Tothill Fields, Lambeth, and Camberwell.

Syllabus der Pflanzenfamilien.*—The fourth edition of Engler's Syllabus, following closely on the third, shows but few alterations. The most important are those affecting the lower plants. Recent work on *Dictyota* finds acknowledgment in the inclusion of the Dictyotales under the section Phæophyceæ. There is no alteration in the general plan of arrangement.

HAYATA, B.—**Compositæ Formosanæ.**
[A systematic list of the compositæ known from the island, comprising thirty-nine genera.] *Journ. Coll. Sci. Imp. Univ. Tokyo*, xviii. Art. 8 (1904) pp. 45 (2 pls.)

MILLIKEN, J.—**A review of Californian Polemoniaceæ.**
[A systematic account, including six genera and about 150 species, with descriptions of the species and their distribution within the area.] *University of California Publications*, ii. (1904) pp. 1-71 (11 pls.).

CRYPTOGAMS.

Pteridophyta.

Ferns of Tropical America.†—G. Hieronymus gives a systematic account of the numerous Pteridophyta collected by F. C. Lehmann and others in Guatemala, Columbia, Ecuador, etc. The collections made by A. Stübel in the Andes are also quoted in some cases, but will soon appear as a whole in a separate publication. The author has been occupied for some years on the work, and has contrived to obtain a sight of all the original specimens of Swartz and more recent authors. The present section of the paper includes 315 species, many of which are new, comprises an abundance of critical notes, and extends from *Trichomanes* to *Elaphoglossum*. The genera are accepted as defined in Engler and Prantl's "Pflanzenfamilien." The author rejects the usually accepted principle that the first species described under a new genus is the type of that genus. For instance, eight of the twelve species which Richard put in his *Nephrodium* have had to be separated off and placed in six other genera, the type species among them. The remain-

* Syllabus der Pflanzenfamilien. By A. Engler. 4th ed., 8vo, xxx. and 237 pp. Borntraeger, Berlin, 1904.
† Engler's Bot. Jahrb., xxxiv. (1904) pp. 417-560.

ing four species constitute a relative majority which, according to the author, are entitled to retain the name *Nephrodium*.

ANONYMOUS—**Rare Ohio Grape Ferns.** *American Botanist*, vi. (1904) p. 35.

BERNATSKY, J.—**Die Farne des Deliblater Sandes und ihre pflanzengeographische Erklärung.** (The Ferns of the Deliblat Sand, and their explanation from a botanico-geographical point of view.) *Ann. Mus. Nation. Hungarici*, 1904, pp. 313–19.

BRIQUET, J.—**Note sur deux rares Fougères du Jura savoisien: Polypodium serratum, Aspidium angulare.** (Note on two rare ferns of the Savoy Jura.) *Arch. Flore Jurass.*, v. (1904) pp. 41–3.

CHRIST, H.—**Primitiæ Floræ Costaricensis. III. Filices et Lycopodiaceæ.** (First-fruits of the Flora of Costa Rica. III. Ferns and Lycopods.) [Continuation.] *Bull. Herb. Boissier*, iv. (1904) pp. 1089–1104.

DRUERY, C. T.—**Devonshire Ferns.**
[List of 15 species; conditions under which they grow.] *Gard. Chron.*, xxxvi. (1904) pp. 233–4.

EASTMAN, H.—**New England Ferns and their common allies.**
[An illustrated non-technical field book.] Boston, 1904, 160 pp.

FORD, S. O.—**The anatomy of Psilotum triquetrum.**
[Anatomical details, with some deductions as to the affinities of the genus with the Sphenophyllales and other fossil plants.] *Ann. Bot.*, xviii. (1904) pp. 589–605 (1 pl.).

GOEZE, E.—**Die Baumfarne.** (Tree-ferns.) *Wiener Ill. Gart. Zeit.*, xxix. (1904) pp. 382–90, 420–7.

HILL, T. G.—**On the presence of a Parichnos in recent plants.**
[The Parichnos of Lepidodendron, etc., may be represented by the degenerated mucilage-canals found at the base of the sporophylls of *Isoetes hystrix*, etc. *Ann. Bot.*, xviii. (1904) p. 654.

LANG, W. H.—**On a prothallus provisionally referred to Psilotum.**
[Description of the structure of a specimen found imbedded among the roots covering the stem of a tree-fern in Perak.] *Tom. cit.*, pp. 571–7 (1 pl.).

MAKINO, T.—**Observations on the Flora of Japan.**
[Contains descriptions of 7 ferns, *Woodsia* and *Isoetes*, with a new species and a new variety.] *Tokyo Bot. Mag.*, xviii. (1904) pp. 129–138.

NICOLAI, W.—**Bilder aus der Heimat der Baumfarne.** (Pictures from the home of tree-ferns.) *Gartenwelt*, ix. (1904) pp. 25–26 (4 pls.).

PORTER, T. C.—**Catalogue of the Bryophyta and Pteridophyta of Pennsylvania.** Boston, 1904, 66 pp

ROBINSON, J. F.—**Lastræa Thelypteris Presl. in East Yorkshire.** *Naturalist*, 1904, p. 348.

ROBINSON, C. B.—**The Ferns of Northern Cape Breton.**
[On this island occur about 26 species of ferns, some of which are rare on the Nova Scotia peninsula.] *Torreya*, iv. (1904) pp. 136–8.

SOMMIER, S.—**A proposito di un esamplare di Osmunda regalis proveniente dalle foreste del Caucaso.** (Concerning a specimen of *O. regalis* brought from the forests of the Caucasus.)
[A specimen with a huge trunk of great age, but surpassed in size by some that were growing till recently in the Italian island of Giglio.] *Bull. Soc. Bot. Ital.*, 1904, p. 305.

UNDERWOOD, L. M.—**The early writers on Ferns and their Collections. III. W. J. Hooker, 1785–1865.**
[A short critical account of the influence exerted by Sir William Hooker, and some of his contemporaries, upon the systematic study of ferns; with a chronological table showing the longevity and period of publication of the chief fern authorities of last century.] *Torreya*, iv. (1904) pp. 145–50.

WATERS, C. E.—Asplenium ebeneum proliferum.
[A further note on this rare and neglected form.]
Rhodora, vi. (1904) p. 210.

ZEILLER, R.—L'Hymenophyllum tunbridgense au Mondarrain (Basses-Pyrénées.).
(*Hymenophyllum tunbridgense* on the Mondarrain.)
[This species has been re-found in Jan. 1904 in the same locality as indicated by Darracq in 1846, and often since then denied.]
Bull. Soc. Bot. France, li. (1904) p. 259.

Bryophyta.

Sphagna from the Environs of Paris.* — F. Camus has worked out the various species of *Sphagnum* in the neighbourhood of Paris. He gives a synoptical table of the characteristics of 18 species which either do or should exist in that region. Then follows an account of 16 species found by himself or otherwise authenticated, with their localities. The delimitation, grouping and nomenclature of the species is based on the works of Russow and of Warnstorf.

The same author records the occurrence of *Sphagnum Russowii* Warnst. in the forest of Marly near Paris, where it is very rare and apparently in process of extinction. He considers that this species and *S. Girgensohnii* Russ., found in the forest of Montmorency, are two survivors of an epoch in which the climate was much less cold than at present.

Easy Identification of Hepaticæ.† — A. J. Grout publishes a preliminary paper on the identification of hepaticæ by means of a hand-lens, and gives some similar keys to the families, genera, and some twenty to thirty of the species found in the eastern United States. These keys are applicable to the plants in the fresh state. He adds some elementary information as to the external structure of hepatics, and appeals for data as to the time of maturity of the spores in the different species.

Rare Scottish Hepaticæ.‡—S. M. Macvicar publishes critical notes on the following species which appeared in his 'Census of Scottish Hepaticæ' in a previous number of the same journal: *Marsupella olivacea* Spruce (which proves to be a variety of *Gymnomitrium adustum* Nees), *M. Sprucei* (Limpr.), *M. erythrorhiza* (Limpr.), *M. sphacelata* (Gies.), *M. Jörgensenii* Schiffn., *Lophozia Wenzelii* (Nees), *L. longidens* (Lindb.), *Plagiochila exigua* Tayl. This last species is shown to be synonymous with *P. tridenticulata* Tayl., and with Hooker's *Jungermannia spinulosa* var. *tridenticulata*.

Cincinnulus trichomanis.§ — I. Douin has had opportunities of studying this not uncommon hepatic, the morphology of which has hitherto been incorrectly described. The sporogonium is developed in a curious subterranean fleshy pouch, the perigynium. Douin gives a more thorough and detailed account of this pouch than has yet been

* Bull. Soc. Bot. France, l. (1903) pp. 165–8, 239–52, 272–289.
† Bryologist, vii. (1904) pp. 89–98, figs. in text.
‡ Ann. Scot. Nat. Hist., 1904, pp. 234–6.
§ Rev. Bryol., xxxi. (1904) pp. 105–16, figs.

forthcoming, and of its development from a very short lateral branch, which bears a few archegonia at its extremity, and after their fertilisation resumes growth at its base, and by very unequal and lop-sided development gradually is converted into a deep sac imbedded in the ground, the archegonia being now situated at the bottom of the sac and pointing upwards instead of downwards. Further details are given; and it is shown that authors are in error about the inflorescence. This he finds to be variable—paroicous, synoicous, or monoicous. He describes some stages in the development of the sporogonium; and compares the species with *Calypogeia ericetorum* and other marsupioid genera, and adds some notes on *Cincinnulus argutus*.

BALLÉ, E.—**Première liste des Mousses recoltées aux environs de Vire (Calvados).** (First list of mosses collected in the environs of Vire.)
[List with localities of 114 species and varieties.]
Bull. Acad. Int. Geogr. Bot., xii. (1903) pp. 153–60.

BÉGUINOT, A.—**Notizie preliminari sulla briogeografia dell' Arcipelago toscano.** (Preliminary notes on the bryo-geography of the Tuscan Archipelago.)
Rendic. Congres. Bot. Palermo, 1904, pp. 96–102.

BLIND, C.—**Les Sphaignes de la région jurassienne.** (Sphagna of the Jura region.)
Bull. Soc. Nat. de l'Ain, i. (1903) [1904] pp. 36–41.

CAMUS, F.—**Muscinées recuillies en Corse en mai et juin, 1901.** (Muscineæ collected in Corsica in May and June, 1901.)
[The author raises the previous total record, 274, to 389 species, comprising 290 mosses, 8 sphagna, and 91 hepatics. *Cephalozia Columbæ* is new to science.]
Bull. Soc. Bot. France, xlviii. (1901) pp. 151–74.

„ „ **Le Harpanthus Flotowianus Nees ab. Esenb. en France.** (*Harpanthus Flotowianus* in France.)
[An hepatic new to France, recently found in an old collection made by Puget in Savoy. 1850–70.]
Tom. cit., pp. 148–51.

„ „ **Muscinées rares ou nouvelles pour la région bretonne-vendéenne.** (Muscineæ new or rare in the region Brittany-Vendée.)
[Includes 15 species new to the region.]
Bull. Soc. Sci. Nat. Ouest, Nantes, 1903, pp. 297–326.

CHUDEAU, R., AND DOUIN.—**Pyramidula algeriensis sp. n.**
[Gathered near Constantine.] Chartres, 1904, 3 pp., 1 fig.

COZZI, C.—**Gli Sfagni nell' agro Abbiatense.** (Sphagnaceæ of the Abbiate plain.
Boll. del Natural., xxiv. (1904) pp. 25–6.

CUFINO, L.—**Pugillus cryptogamarum canadensium.** (A handful of Canadian cryptogams.)
[List of 12 mosses, 4 hepatics, and 16 lichens gathered by A. Hill in Western Canada.] *Malpighia*, xviii. (1904) pp. 559–62.

DÉPALLIÈRE, CL.—**Essai sur les Muscinées de l'Ain.** (Essay on the Muscineæ of Ain.)
[Contains about 300 species.] *Bull. Soc. Sci. Nat. Arch. de l'Ain*, i. (1904) pp. 4–29.

DISMIER, G.—**Observations sur l'inflorescence du Bryum pallescens Schlea.** (Observations on the inflorescence of *B. pallescens*.)
Compt. Rend. Congr. Soc. Sav. Paris, 1903, 5 pp.

„ „ **Premières recherches bryologiques dans le département de la Haute-Marne.** (First bryological researches in the department of Haute-Marne.)
[Records 163 mosses. 1 sphagnum, and 29 hepaticæ, with localities. The soil is chiefly calcareous. The department had scarcely been explored for mosses before.].
Bull. Soc. Bot. France, li. (1904) pp. 260–9.

DISMIER, G.—**Le Lejeunea Rossettiana Mass. dans le Dauphiné.** (*Lejeunea Rossettiana* in Dauphiny.)
[This hepatic, very rare in France, has been found on the Col de Saulce at about 1100 metres.]
Op. cit., l. (1903) pp. 289–90.

DIXON, H. N.—**Campylopus atrovirens De Not. c. fr. A correction.**
[Calls attention to the little-known fruit of this moss, which was discovered more than thirty years ago in the Pyrenees.]
Rev. Bryol., xxxi. (1904) p. 123.

GLOWACKI, J.—**Beitrag zur Laubmoosflora von Gmünd in Karnten.** (Contribution to the moss-flora of Gmünd in Carinthia.)
Jahrb. Naturk. Mus. Karnten. Klagenfurt., xxvii. (1904) pp. 93–128.

HERZOG, TH.—**Die Laubmoose Badens. Eine bryogeographische Skizze.** (A bryogeographic sketch of the mosses of Baden.)
[Continuation.] *Bull. Herb. Boissier*, iv. (1904), pp. 1137–54, 1241–56.

HILLIER—**De la dispersion de l'Hypnum aduncum dans la région jurassienne.** (On the distribution of *H. aduncum* in the Jura.)
Arch. Flor. Jurass., 1903, p. 101.

HOWE, M. A.—**Exogenous origin of Antheridia in Anthoceros.**
[An expression of doubt as to whether the bodies so described by E. Lampa, in *Oest. Bot. Zeitschr.*, liii. (1903) pp. 436–8, may not rather be tubers.]
Torreya, iv. (1904) pp. 175–6.

INGHAM, W.—**Yorkshire Mosses and Hepatics.**
[Occurrence of *Campylopus atrovirens* var. *muticus* Milde, *Dicranum scoparium* var. *orthophyllum* Brid., *Weisia calcarea* var. *mutica* Boul., *Nardia minor* Nees, in Yorkshire.] *Naturalist*, 1904, p. 286.

MATOUSCHEK, F.—**Beiträge zur Moosflora von Ober-Oesterreich. I Teil.** (Contributions to the moss-flora of Upper Austria. Part I.)
[Critical enumeration of old and new finds.]
62 *Jahresb. d. Mus. Francisco-Carolinum. Linz.*, 1904, pp. 1–22.

PAINTER, W. H.—**Mosses and Hepatics of Llanwrtyd, Breconshire.**
[A list of 99 mosses and 11 hepatics.]
Journ. of Bot., xlii. (1904) pp. 335–7.

PARIS, E. G.—**Muscinées de l'Afrique occidentale française.** (Muscineæ of French West Africa.)
[Contains 26 mosses and 2 hepatics, including descriptions of 16 new mosses.] *Rev. Bryol.*, xxxi. (1904) pp. 117–23.

„ „ **Index Bryologicus.** 2nd ed., ii. (1904) fasc. 5–6, pp. 257–375.

PORTER, T. C.—**Catalogue of the Bryophyta and Pteridophyta of Pennsylvania.**
Boston, 1904, 66 pp.

PODPĚRA, J.—**Ein Beitrag zur Laubmoosflora Böhmens.** (A contribution to the Bohemian moss-flora.)
[List of 84 mosses, with descriptions of three new varieties.]
Verh. k. k. zool. bot. Ges. Wien, liv. (1904) pp. 507–15.

„ „ **Výsledky bryologického výzkumu Moravy za rok 1903–4.** (Results of the bryological exploration of Moravia in the years 1903–4.)
Jahrb. Naturh. Klubs in Prossnitz in Mähren, 1904, 30 pp.

ROTH, G.—**Die Europäischen Laubmoose.** (The Mosses of Europe.)
Band ii. Lief 10 (Leipzig, 1904) pp. 513–640, pls. xli.–l.

SOMMIER, S.—**Alcune piante recentemente racolte all' Elba, non ancora indicate per quest' isola.** (Some plants recently gathered in Elba, not yet recorded for this island.)
[Among the new records are *Tesellina pyramidata* and *Riccia papillosa*.]
Bull. Soc. Bot. Ital., 1904, pp. 304–5.

STEPHANI, F.—**Species hepaticarum.** (Species of hepatics.)
[Monograph of *Plagiochila*, continued.]
Bull. Herb. Boissier, iv. (1904) pp. 1197–1214

WARNSTORF, C.—Laubmoose. (Mosses.)
Kryptogamenflora der Mark Brandenburg, Abt. I., Band ii., pp. 241–432, Leipzig, 1904 (figs.).

YOSHINAGA, J.—Hepaticæ and Fungi around the Marine Biological Station at Misaki.
[List including 12 hepatics.] *Bot. Mag. Tokyo*, xviii. (1904) pp. 216–217.

Thallophyta.

Algæ.

Morphology and Biology of Algæ.* — F. Oltmanns publishes the first volume of his great work under the above title. This volume consists of a treatment of the separate families under nine different groups: I. Chrysomonadineæ. II. Heterocontæ. III. Cryptomonadineæ. IV. Euglenaceæ. V. Dinoflagellata. VI. Acontæ. VII. Chlorophyceæ. VIII. Phæophyceæ. IX. Rhodophyceæ. The author omits Cyanophyceæ, as he holds that that group is too closely related to Bacteria to be considered apart from such genera as *Cladothrix*, *Beggiatoa*, etc. On the other hand he includes Charales and the coloured Flagellata; the latter group being in his opinion an essential part of any treatment of algæ, since the Flagellata are becoming more and more regarded as the ancestors of the algæ. Bangiales are inserted between Phæophyceæ and Rhodophyceæ. The arrangement of the Orders is in some cases different from that usually accepted. The treatment of Rhodophyceæ is divided into two sections: (1) Structure of the vegetative organs; and (2) Reproduction. The different Orders are dealt with separately from these two points of view. The book is well illustrated by new and old figures.

Behaviour of Marine Algæ in Relation to Salinity.†—K. Techet continues the publication of his observations on this subject. He says that the individual power of accommodation to changes of salinity in marine algæ is very large, and he gives instances of extremes in which various species could live. *Cladophora trichotoma* can bear water varying between 1·8 p.c. and 8·5 p.c. When the salinity was raised to 13·2 p.c., the plant produced plentiful swarm-spores and perished. Other algæ of which statistics are given are: *Chætomorpha aerea*, *Ectocarpus* sp., and *Peyssonellia Dubyi*. As examples of the power of certain algæ to accommodate themselves to varied salinity, the author mentions the small rock-pools along the coast, where algæ are subjected to the access of sea or rain-water, as well as to considerable concentration on hot, dry days, at neap tides. The inhabitants of such pools consist mainly of Cyanophyceæ.

Sphacelariaceæ.‡ — C. Sauvageau publishes the second fascicle of his remarks on the Sphacelariaceæ, some of the separate parts of which

* Morphologie und Biologie der Algen, i., pp. vi., 733, 3 coloured and 473 plain figs. in text. G. Fischer, Jena, 1904.
† Oesterr. Bot. Zeitschr., liv. (1904) pp. 367–73.
‡ Remarques sur les Sphacelariaceæ. fasc. ii. (1904). Republished from Journal de Botanique, 1902–1904.

have already appeared in the "Journal de Botanique." In the present volume he continues his treatment of *Halopteris*, and deals with *Phlæocaulon* and *Ptilopogon*. He includes twelve species in the genus *Halopteris*, and for the convenience of students he draws up two keys, one for naming fertile and the other sterile specimens. Several species hitherto known under other generic names are here placed in this genus. *Phlæocaulon* contains three species, and the author shows the characteristics which distinguish it from the genera *Chætopteris* and *Halopteris*. *Ptilopogon* is only begun, and one species is described, *P. botryocladus* Reinke. The work is to be continued. A bibliographical index is given of the memoirs quoted.

Cytology of Nemalion multifidum.* — J. J. Wolfe fills with this paper a gap in our knowledge of the cytology of Florideæ. He divides his paper into four sections: A. Methods. B. The cell. C. Maturation and sexual reproduction. D. Mitosis. Under the cell he treats of (*a*) the structure of the chromatophore; (*b*) division of the chromatophore. The third section is divided into (*a*) oogenesis; (*b*) spermatogenesis; (*c*) fertilisation and development of the cystocarp. The fourth section consists of (*a*) the nucleolus; (*b*) reduction. The chromatophore is present in all cells of the plant, except the mature antheridium and the two sperm-cells to which it gives rise. It is in the form of a hollow ellipsoid, from which processes radiate to the periphery of the cell and there flatten out to form a clathrate membrane. The sex-organs cannot be regarded as unicellular structures, and the reasons for this are detailed. In the nucleus the entire chromatin content is stored in the nucleolus, and, in the prophases of division, passes to the nuclear wall along delicate fibrillæ. The spindle is intra-nuclear, and centrosomes are distinctly visible at the poles at metaphase. The author concludes that *Nemalion* presents the essentials of an antithetic alternation of generations, and that the cystocarp is therefore the homologue of the sporophyte in higher plants. This conclusion he bases on the fact that approximately sixteen chromosomes are present in the divisions of the cells of the cystocarp up to the period of spore-formation, and approximately eight in those of the thallus; the reduction division being immediately associated with the production of the carpospores.

Chantransia Alariæ.†—This species, which has hitherto only been recorded from Iceland and the Faeröes, has now been found by J. Adams at Portrush, co. Antrim, growing on the lamina of *Alaria esculenta*. It differs from the type in being somewhat smaller and in having alternate and not opposite monosporangia. Neither antheridia nor cystocarps were observed. Hairs were not found terminating the filaments, though they may have been present earlier in the year.

Rhipidosiphon and Callipsygma.‡—A. and E. S. Gepp give an account of these two rare monotypic genera, both of which have been placed in Codiaceæ. In the original description of *Rhipidosiphon javensis* by Montagne, the plant is described as being fan-shaped, with dicho-

* Ann. Bot., xviii. (1904) pp. 607–27 (1 fig. in text), 2 pls.
† Journ. Bot. xlii. (1904) pp. 351–2. ‡ Tom. cit., pp. 363–6 (1 pl.).

tomous and anastomosing filaments. Up to the present time it has never been recorded again. The authors of the present paper have however found it among the material collected in the Dutch East Indies by the Siboga expedition, and have been able to prove that the supposed anastomosis of the filaments does not exist. The anastomosis figured and described by Montagne takes place—not indeed between the filaments, but between the lines of calcareous cement, which fills the grooves between contiguous filaments. Montagne made his drawings and observations from calcified specimens, and mistook the dark lines of calcification for the filaments of the thallus; these latter appearing in a calcified plant almost transparent by contrast with the opaque connecting lines of calcium carbonate. The presence of anastomosis between the filaments having been disproved, the genus cannot be maintained. *Rhipidosiphon* is nothing but a simple *Udotea*, and is here placed in that genus under the name of *U. javensis*. *Callipsygma* has only been found once, at Port Phillip, Victoria; and half of the original plant is preserved at Lund, while half is in the British Museum. It is here figured for the first time, and further details are added to our knowledge of its structure. The stipe is two-edged, uncalcified, and throws out at the margins complanate rachides, which grow out each into a terminal flabellum. The whole plant is complanate and uncalcified, and bears no resemblance to *Rhipocephalus*, with which genus it has been compared. The plant appears to be transversely septate, but a careful examination under high magnification shows that the septa are perforated, and are in fact nothing but thick rings of cellulose which have grown inwards from the sides, similar to the plugs or stoppers in *Codium* and other allied genera. Figures are given of the two genera described.

Oogenesis in Vaucheria.*—B. M. Davis has made a minute study of this phenomenon in *Vaucheria geminata* var. *racemosa*, and comes to the following conclusions. The number of nuclei in the young oogonium ranges from twenty to fifty. There are no mitoses in the oogonium. It becomes separated from the parent filament by a cross wall, and is multinucleate at the time the cross wall is formed. Even before this wall is complete, a process of nuclear degeneration is evident, and it continues until only one nucleus remains in the oogonium. The degenerating nuclei are found chiefly in the periplasm. They become exceedingly small, the nuclear membrane disappearing first, and finally nothing remains but granular matter, apparently nucleolar in nature. There is apparently no cœnocentrum in the egg of *Vaucheria*, but the surviving nucleus lies at the centre of the oogonium. The egg nucleus grows rapidly until it is three or four times the size of the nuclei in the young oogonium, and there is a marked increase of chromatin. After fertilisation the nucleus of the sperm passes to the centre of the egg and increases in size, at the side of the female nucleus. The two fuse slowly when both are of approximately the same size. The process of oogenesis in *Vaucheria* agrees in a striking manner with that in *Saprolegnia* and the Peronosporales. The paper ends with a discussion of the

* Bot. Gazette, xxxviii. (1904) pp. 81–98 (2 pls.).

evolutionary processes affecting multinucleate organs in the Phycomycetes and possible algal relatives.

Œdogonium.* — F. E. Fritsch continues his algological notes, the latest being a description of the structure of a young *Œdogonium* which he has had under observation for two years. The lowest (attaching-) cell could scarcely be called hemispherical. In a large proportion of young plants the lower surface of the basal cell was more or less completely enveloped by a hyaline substance, of a mucilaginous nature; and this served to attach the filaments to the substratum. The apical cell was provided with a longer or shorter cap of cell-wall substance with square corners, so that the apex of the filament had a rectangular appearance. It fitted tightly over the filament, which was V-shaped at the apex. This abnormal cap is attributed by the author to the growth of the plants under unfavourable conditions. The theories of Wille and Hirn regarding the mode of origin, etc., of the cap of *Œdogonium*, are discussed, the author agreeing with the views held by Wille. The cell-contents of Fritsch's plants point also to abnormality of condition.

Ægagropila Sauteri.† — Wesenberg-Lund has studied the growth of this alga in the lake of Sorö in Denmark, where it is very common. Every spring the large spherical bodies are seen floating on the surface of the water. The bottom of the lake at a depth of about 4 metres is covered with a dense layer of small individuals, 10–20 mm. long, which forms coherent strata on stones and other bodies. In shallower water (1–1·5 m.) this layer does not occur, but spherical bodies are found lying loosely on the bottom; and these bodies rise in spring to the surface. The rising is caused by the assimilation, the bubbles of air not being able to escape from the central parts of the densely aggregated filaments of the sphere.

Northern Plankton.‡ — N. Wille undertakes the working out of those species of Schizophyceæ which form part of the plankton in latitudes above 50° N. lat. A large work on the plankton of these regions is in course of publication, divided into twenty-one parts, each of which will appear as it is ready. Each species will be fully described, with a figure of the habit and possibly of the structure as well. The part dealing with the Schizophyceæ contains also keys to the genera and species, with lists of synonymy and interesting remarks on distribution. The systematic treatment is preceded by an introduction dealing with the structure and life-history of the group. The author remarks that the number of species diminishes from the equator northwards and southwards, until in the polar seas not one indigenous species would probably be found.

Phyto-plankton of Asia Minor.§—A. Forti has examined the phyto-plankton of three lakes in Anatolia, and publishes his results. The first lake is Abullonia-Göl, which is so shallow as to allow a boatman to

* Ann. Bot., xviii. (1904) pp. 648–53 (1 fig. in text).
† Acad. Roy. Sci. Danemark, Bull., 1903, pp. 167–204 (1 map).
‡ Nordisches Plankton, Kiel, pt. xx. (1904) 29 pp.
§ Nuov. Notar., xvi. (1905) pp. 1–14.

touch the bottom in many places with his oar. From this lake the author records 35 species of Mastigophoræ, Peridinieæ, Bacillarieæ, Chlorophyceæ, and Myxophyceæ. Some of these had not been previously recorded from that locality. From Lake Izsnik-Göl, or the Lake of Nicea, 26 species are enumerated, including a new variety, *recta*, of *Anabæna spiroides* Kleb. From the Lake of Sapandia, which had never been examined for phyto-plankton, the author records 28 species as the result of 5 days' haul. As a result of the examination of these lakes A. Forti holds that a lake of which the area does not correspond to an adequate depth, fails to show a true and proper limno-plankton. He also considers that his results strengthen Ostwald's theory of the gradual diminution of plankton from the pole to the equator.

Chrysomonadineæ.*—A. Scherffel contributes three interesting notes to our knowledge of this order. The first is on those species which possess the power of taking up animal organisms for nourishment, though possessing chromatophores. The number of these species is larger than had been supposed. The author has himself watched a fine group of twenty-one well developed *Chrysamœbæ*, which contained various bacteria and other extraneous bodies; and one of them was observed in the act of annexing to itself a fair-sized *Navicula*. The second note deals with a form of *Mallomonas* with two cilia, closely allied to *M. acaroides* Perty. The author suggests that this may perhaps explain Stein's assertion that he had seen *M. acaroides* with two cilia. The question as to a connection between *Mallomonas* and *Synura* is still doubtful, and the views of various authors on the point are discussed. The third note is entitled "The eye-points (*Augenpunkte*) of *Synura* and *Syncrypta*." The two genera are regarded as quite distinct, though closely allied. One main difference is the common gelatinous envelope in *Syncrypta*, which encloses the whole colony. This does not occur in *Synura*. The so-called "*Augenpunkte*" of both genera may be nothing but pigment-drops.

BACHMANN, H.—**Botanische Exkursionen im Golfe von Neapel.**
Jahresber. Höhern. Lehranst. Luzern, 1903–4, 53 pp. (illus.).

BOLOCHONTZEW—**Phytoplankton der Seen im Kreise Rostow.** (Phytoplankton of lakes in the district of Rostow.) *Zemleweveṇje*, 1904.

CUSHMAN, J. A.—**Desmids from Newfoundland.**
[A list of 20 species from Rose au Rue, including two novelties—*Euastrum Allenii* and *Micrasterias conferta* var. nov. *Novæ-terræ*.]
Bull. Torrey Bot. Club, xxxi. (1904) pp. 581–4.

FRITSCH, K.—**Botanische Section des naturwissen schaftlichen Vereins für Steiermark in Graz.** (Botanical section of the Natural Science Society of Styria in Graz.)
[Records the finding of *Œdogonium undulatum* in ponds near Wandschuh, by Graz.] *Oesterr. bot. Zeitschr.*, liv. (1904) p. 191.

HEERING, W.—**Ueber einige Süsswasseralgen Schleswig-Holsteins.** (On some fresh-water algæ of Schleswig-Holstein.)
Mitt. Altona Mus., 1904, pp. 1–32 (25 figs.).

* Ber. Deutsch. Bot. Gesell., xxii. (1904) pp. 439–44.

Howe, M. A.—Collections of marine algæ from Florida and the Bahamas.
[A short report of the work done by the author while collecting and studying the marine algæ of that region. The specimens are represented by 616 collection numbers.]
Journ. New York Bot. Garden, v. (1904) pp. 164–6.

" " **Remarks on some West Indian Marine Algæ.**
[The author enumerates a few of the genera found by him during his recent stay in the Bahamas and Florida, and he adds some interesting remarks on *Rhipocephalus oblongus*. A new species of *Halimeda* is mentioned, which is to be described shortly.] *Torreya*, iv. (1904) pp. 126–7.

Hyams, Isabel F., & E. H. Richards—Notes on Oscillaria prolifica.
[Third paper. Colouring matters.]
Technology Quarterly, xvii. (1904) pp. 270–6.

Kohl, F. G.—Ueber die Organisation und Physiologie der Cyanophyceen-Zelle und die mitotische Theilung ihres Kernes. (On the organisation and physiology of the Cyanophyceæ cell and the mitotic division of its nucleus.)
1903, 240 pp. (10 pls.).

Kuckuck, P.—Neue Untersuchungen über Nemoderma Schousboe. (New investigation on *Nemoderma*.) *Wiss. Meeresunt. Biol. Anst. Abth. Helgoland*, v. (1904) pp. 117–50.

Morteo, E.—Contributo alla conoscenza delle alghe di acqua dolce in Liguria. (Contribution to a knowledge of the fresh-water algæ of Liguria.)
[A list, with critical and topographical notes.]
Malpighia, xviii. (1904) pp. 389–466

Pavillard, J.—Sur les auxospores de deux Diatomées pélagiques. (On the auxospores of two pelagic diatoms.)
[A note, in which the auxospores of *Rhizosolenia Stolterforthii* and *Hemiaulus chinensis* are described.] *Comptes Rendus*, cxxxix. (1904) pp. 615–7.

Peragallo, M.—Première note sur les Diatomées marines de Monaco. (First note on the marine diatoms of Monaco.) *Bull. Musée Océanogr. Monaco*, 1904, 16 pp., 8 figs

Petit, P.—Diatomées recoltées en Cochinchine. (Diatoms collected in Cochin-China.)
[Contains four lists of species—from Tonkin, Annam (fresh-water and marine), and Ceylon respectively. The new species described are: *Surirella Boisiana*, *S. cochinchinensis*, *S. touranensis*, and *Achnanthes orientalis*.
Nuov. Notar., xv. (1904) pp. 161–8 (1 pl.).

Reinsch, P. F.—Die Zusammensetzung des "Passatstaubes" auf dem südlichen atlantischen Ozean. (The composition of atmospheric dust in the South Atlantic Ocean.) *Flora*, xciii. (1904) pp. 533–6.

Tempère, J.—Liste des Diatomées contenues dans le dépôt calcaire bitumineux tertiaire de Sendaï, Japon. (List of diatoms contained in the layer of tertiary calcareous bitumen at Sendaï, Japan.) *Microg. Prép.*, xii. (1904) pp. 175-89.

Zacharias, O.—Ueber verticale Wanderungen des Zooplanktons in den baltischen Seen. (On the vertical wanderings of zooplankton in the Baltic lakes.) *Biol. Centralbl.*, xxiv. (1904) pp. 637–8.

" " **Ueber Grün-, Gelb- und Rothfärbung der Gewässer durch die anwesenheit mikroskopischer Organismen.** (On the green, yellow and red colouring of water through the presence of microscopic organisms.)
Forsch. Ber. Biol. Stat. Plön, 1903, pp. 296–303.

Fungi.

Fertilisation in the Saprolegnieæ.*—A. H. Trow has published further observations on the cytology and fertilisation of *Achlya polyandra* and *A. De Baryana*. He goes over the whole group, noting the points that have been successfully investigated by various workers, and re-affirms the correctness of his own conclusions as to fertilisation in certain members of this family. He finds in *Achyla polyandra* that at an early stage of the oosphere after "balling" has taken place only one nucleus is present, at a later stage two nuclei, and still later again one. He has observed again and again the order 1–2–1, which of itself, he holds, proves the process of fertilisation of the oosphere. Further, he found and figured a fertilisation tube in open communication with the oosphere. He made similar observations in *A. De Baryana*. In the oogonium and antheridium of this species, on first formation, there are a number of nuclei which undergo a first and second mitosis. During the latter division the chromosomes are reduced from eight to four, and centrosomes and astrospheres are observed for the first time in the oogonial nuclei. "Balling" of the different oospheres takes place after the degeneration of the supernumerary nuclei, and the oospheres seem to be uninucleate until the entrance of the male nucleus from the fertilisation tube of the antheridium. The male nucleus acquires a centrosome and astrosphere after passing into the oosphere. During maturation of the oospore the wall thickens and granules of reserve-material collect in the protoplasm. At this stage fusion of the two nuclei takes place, centrosomes and astrospheres having disappeared from both nuclei. Here, as in *A. polyandra*, Trow finds the recurrence of the formula 1–2–1, indicating the succession of nuclei, and again proving fusion and consequently fertilisation.

Studies on the Fertilisation of Albugo Lepigoni and some Peronosporeæ.†—W. Ruhland finds that *Albugo Lepigoni* is the species of the genus in which there is the greatest reduction of nuclei, as only one of the originally large number passes from the periplasm to the oosphere. In the other species there is copulation between a number of male and female nuclei, or, where one alone persists, there are at first a large number in the oosphere. This phenomenon bespeaks a close connection between *A. Lepigoni* and other Peronosporeæ, although the formation of chained conidia marks a wide difference between the genera.

Vegetable Pathology.‡—Under this title G. Cuboni gives an account of a disease of wheat caused by *Sclerospora macrospora*. This fungus has been included among the Peronosporeæ, but according to the observations of Cuboni and others, the hyphæ are intra-cellular, they never form haustoria, and they never produce conidiophores. The author tried in every possible way to induce the growth of conidiophores, without success. The wheat is invariably attacked after an

* Ann. Bot., xviii. (1904) pp. 541–69 (3 pls.).

† Jahrb. wiss. Bot., xxxix. (1904) p. 135. See also Bot. Centralbl., xcvi. (1904) p. 340–1.

‡ Atti Reale Accad. Lincei, ccci. (1904) pp. 5[illegible]–7.

inundation of the river, when the host-plant has been under water for some time. The disease is made noticeable by the whitened aspect of the leaves; closer examination shows the development of the fungus chiefly along the veins. The best way to demonstrate its presence is to soak the leaf for a time in iodide of potassium, when the mycelium will be found to be coloured a deep brown. The author is doubtful if this fungus really belongs to the genus *Sclerospora* or to the Peronosporeæ.

G. D'Ippolito and G. B. Traverso* have also studied the same fungus in its effect on *Zea Mays*. They found that the plants attacked produced almost exclusively male flowers. The morphology of the deformed flowers is described.

Fungi Causing Fermentation.† — In the Province of Che-Kiang in China, an alcoholic drink is made from fermented rice, and the ferment in portable form consists of cakes made from wheat-meal. K. Saito undertook the examination of these cakes, and found that the particles of wheat were penetrated through and through by the mycelia of various fungi, *Penicillium glaucum*, *Aspergillus glaucus*, *Asp. flavus*, *Mucor racemosus*, *Monilia* sp., etc. He found also in great abundance a species of *Rhizopus*, which he has described and figured, and which he names *Rhizopus chinensis*. Still another species was cultivated and diagnosed, *Rhizopus Tritici*.

The moistened rice forms a favourable medium for the growth of these fungi; fermentation follows, and a yellow liquid is formed with an agreeable odour.

C. Wehrner ‡ describes *Mucor javanicus*, also a powerful fermenting agent; and though yeast-cells are formed, he considers that the mycelium (and not the yeast) causes the fermentation. He describes the action of other *Mucors*.

Contribution to the Study of Cystopus candidus.§ — Albert Eberhardt has made a biological study of this fungus. He divides his work into two parts: (1) the morphological and histological alterations caused in the host-plants; and (2) specialisation of the parasite.

Cystopus candidus is to be found on a large number of genera of the Cruciferæ. Eberhardt describes the effect of the parasite on many of these, causing various forms of hypertrophy, deformations of all parts of the plant, except the roots and the ovules, though occasionally oospores are found in the ovules of *Lepidium sativum*. The floral leaves persist, but atrophy ensues both of the ovules and of the pollen: the latter usually is undeveloped, the former are small and depressed. The normal branching is interfered with; the branches are short or merely rudimentary. A violet coloration is produced in almost all the cells adjoining those invaded by the fungus. A similar colour is produced in the healthy plant in the parts exposed to excessive light. The writer describes many histological changes induced by the fungus, and

* Stazione sperimentali agrarie, xxxvi. (1903) pp. 975–7 (3 pls.). See also Ann. Mycol., ii. (1904) p. 463.
† Centralbl. Bakt., xiii. (1904) pp. 153-61 (2 pls.).
‡ Tom. cit., pp. 277–80 (2 figs.).
§ Op. cit., xii. (1904) pp. 235-49, 426–39, 614–31, 714–24 (1 pl.).

then gives an account of his research on the specialisation of the parasite. The results obtained are not absolutely conclusive; they point to the existence of but one species of *C. candidus* on all the different hosts, though possibly there may be two biological species, but successful inoculation varied with the age and condition of the host, and these factors rather tended to confuse the issue. In any case, *Cystopus* is not so specialised in its parasitism as the species of Uredineæ have been proved to be.

Perithecium of Monascus.*—H. P. Kuyper has studied the species *Monascus purpureus* and *M. Barkeri*, and publishes his results in two different papers. In neither species does he find pollinodium and ascogonium in open communication. In the ascogonium of *M. purpureus* a number of free cells are formed, originally bi-nucleate: the two nuclei fuse, and the resultant nucleus divides again into many smaller nuclei. In these free cells a varying number of spores are formed. Each spore contains at first one nucleus, which divides later, so that the mature spore is multi-nucleate. The development of *M. Barkeri* is somewhat different: the ascogonium contains a number of nuclei which fuse in pairs; the free cells are then formed, each containing one of these fused nuclei. Spore-formation follows as in *M. purpureus*. The writer looks on the free cells as asci, and he therefore places *Monascus* in a new order, the Endascineæ. He discusses the bearing of these phenomena on the phylogeny of the Ascomycetes.

Disease of Oaks.†—W. Ruhland gives an account of a parasitic fungus that has wrought great damage not only on oaks, but also on other trees. It attacks the stems and branches, which it encircles and so destroys completely the parts above the diseased area. The conidial form of the fungus alone was detected on the tree, but on the dead branches the perfect fruit form developed. Ruhland describes it as a new species, *Dothidea noxia*; the conidial condition as *Fusicoccum noxium*.

New Sclerotiniæ.‡—H. C. Schellenberg records numerous cases of disease due to sclerotia hitherto unrecorded. The fruits of *Sorbus Aria* were mummified by a sclerotium which produced small yellowish apothecia. Fruits of *Sorbus Chamæmespilus* and of *Mespilus germanica* were attacked and sclerotia formed: the apothecium has not been discovered. A *Sclerotinia* discovered on the base of the stalk and the lower leaves of barley produced after two years straw-coloured apothecia, *Sclerotinia Hordei* sp. n. Plants of wheat were found to be attacked by a similar sclerotium; and the author also describes a similar disease on walnuts. Infection takes place shortly after flowering. The hyphæ penetrate the young fruit and very soon destroy it. The apothecia are unknown.

Tropical Hypocreaceæ.§—J. Rick describes three different Hypocreaceæ that he found growing on Arundinarieæ. *Dussiella tuberiformis* forms a stroma on the leaf, where it seems to be epiphytic. A large

* K. Akad. Wetensch. Amsterdam, xiii. (1904) p. 46; Inaug. Diss. Utrecht (1904) 148 pp., 1 pl. See also Bot. Centralbl., xcvi. (1904) p. 386-7.
† Centralbl. Bakt., xii. (1904) pp. 250-3.
‡ Tom. cit., pp. 735-6. § Ann. Mycol., ii. (1904) pp. 402-6 (3 figs.).

part of the stroma was sterile. At the same place he found *Ascopolyporus villosus*, the stroma of which resembles a young *Polyporus*. The third genus on the same host was *Mölleriella* sp. n. The stromata are harder than in *Dussiella*. The spores are at first very long and septate; they leave the ascus in this condition or they remain till fully ripe, when the component cells fall apart and become rounded off. The asci containing the mature spores seem thus to be quite different from those of the earlier stages. Rick discusses the relation of the different genera of Hypocreaceæ to each other.

Laboulbeniaceæ from the Vorarlberg.* — Josef Rick describes a minute fungus that grew on a species of ant, *Myrmica lævinodis*. It consisted of a flask-shaped one-celled male cell, sterile appendages and a rounded gelatinous female cell. At maturity the trichogyne disappears, leaving the perithecium and the ascus with several fusiform spores. The fungus is closely connected with *Laboulbenia*. The animals do not suffer from the parasite.

Ascus form of Aspergillus fumigatus.† — G. Grijns found the perfect fruit of this fungus in a culture of the conidial form. It consisted of small irregular balls that lay on the surface of the nutritive medium. The envelope is composed of hyphæ, of which the short thread-like cells are changed into thick-walled cells. The asci are ovate and thin-walled, the spores red with a central band. The red colouring matter does not appear until the spores are almost mature.

Wild Yeast Infection.‡—A. C. Chapman, in a paper read before the Institute of Brewing, recounts the danger of allowing wild yeasts, that is yeasts other than those cultivated, to enter the brewing vats. Few of these yeasts are Saccharomycetes; they are rather the yeast forms of other fungi. Some of these exercise a very deleterious influence on the taste or odour of the beer, though many of them are harmless and may be neglected. To secure immunity from them, care must be taken that excessive cleanliness prevails in the chambers, and possibly that the entering air should be filtered, but it is rare that mischief has ensued from air-borne yeasts. Heat sterilisation has been found to be largely effectual in getting rid of undesirable growths. The author gives instances of cases of infection that have occurred, and the means taken to destroy the invading yeasts.

Origin of a Rose-coloured Yeast.§—E. Klein and Mervyn Gordon found that the spores of *Puccinia suævolens* grew as yeast spores in favourable media. The colour of the culture was a coral-red. It developed also in milk, but only on the surface of the cream. The yeast was not found to be pathogenic.

Study of Yeast.‖ — W. Henneberg has published results of his research on the life-duration of different yeasts. He took into con-

* Oesterr. bot. Zeitschr. lii. (1903) pp. 159–64 (1 fig.). See also Centralbl. Bakt. xi. (1903) p. 236.
† Centralbl. Bakt., xi. (1903) pp. 330–2 (6 figs.).
‡ Journ. Inst. Brewing, x. (1904) pp. 382–402 (6 pls.).
§ Centralbl. Bakt., Orig., xxxv. (1903) pp. 138–9.
‖ Wochenschr. Braueri., xxi. (1904) pp. 260, 288, 299, 310. See also Ann. Mycol., ii. (1904) pp. 474–7.

sideration the influence of different temperatures, and also the influence of air and humidity. He studied the effect induced by the combined growth of other organisms such as moulds, bacteria, etc., on the life of the yeast, and also on the odour. The results show great variety of effect on the yeast plant.

In another paper* the same author describes the behaviour of certain yeast races at a low temperature. He notes the effect on the cell wall and on the various contents of the cell, glycogen, enzymes, etc.

Research on Yeast.†—H. Will finds that wild yeasts have a greater persistence than the cultivated forms. He gives an account of the conditions, temperature, light, etc., that influence the vitality of the yeast cells.

P. Mazé ‡ gives an account of some new races of the yeasts of lactose. These are to be found chiefly in soft cheese. He gives a long account of their behaviour in different media, and discusses their relation to the cheese. He thinks that probably they contribute to the aroma.

Janssens and Mertens § have worked at one form, a rose-coloured *Torula*, which forms an abundant coating over beer-wort. It develops better in the light than in the dark, and does not induce fermentation. The nucleus of the *Torula* cell divides amitotically and very irregularly.

J. Warschawsky ‖ relates the history of the various discoveries made recently on the fermentation process and on the enzymes that cause the fermentation, and he gives the results of his study as to the conditions under which the zymase is formed and stored up in the yeast cell.

Studies of Uredineæ.¶—E. Jordi describes a series of experiments with the rust *Uromyces Pisi*. He finds that there are two sharply differentiated biological forms. The Æcidium form of each is on *Euphorbia*; the uredo- and teleutospore forms are on the two host-plants, *Lathyrus pratensis* and *Vicia Cracca*. There is very little morphological distinction between the spores of the two fungi.

P. Cruchet** has tested the Uredineæ found on Labiatæ. He finds biological forms there also. Spores that infected *Mentha silvestris* refused to grow on *M. aquatica* and *M. arvensis*, and *vice versa*. He finds that *Æcidium Brunellæ* forms teleutospores on *Molinia*, and that *Puccinia Stachydis* has no Æcidia, and is therefore a *Brachypuccinia*.

Otto Schneider †† describes three species of *Melampsora* growing on *Salix*. He made inoculation experiments with all of them, and gives the various results.

* Zeitschr. Spiritesind., xxvii. (1904) pp. 96–239. See also Ann. Mycol., ii. (1904) pp. 477–9.

† Zeitschr. Gesamt. Brauw., xxvii. (1904) pp. 269–71. See also Centralbl. Bakt., xii. (1904) pp. 311–2.

‡ Ann. Inst. Pasteur, xvii. (1904) p. 11. See also Centralbl. Bakt., xii. (1904) pp. 312–4.

§ La Cellule, xx., fasc. 2, pp. 353–68 (2 pls.). See also Centralbl. Bakt., xiii. (1904) pp. 314–5.

‖ Centralbl. Bakt., xii. (1904) pp. 400–7.

¶ Op. cit., pp. 64–72.

** Tom. cit., pp. 95–6.

†† Tom. cit., pp. 222–4.

Ed. Fischer* gives a list of Uredineæ found in Switzerland in 1903, with a description of one new species. He has also found by experiment that *Æcidium Linosyridis* produces its teleutospores on *Carex humilis*.

In "Notes on Uredineæ III." E. W. D. Holwey† gives a detailed account of some plants of *Puccinia atrofusca* first described as a *Uromyces*. He describes the amphispores of the species, thick-walled and echinulate, with two equatorial germ-spores.

V. Brizi‡ describes a disease of *Cichorium Endivia*, the leaves of which were covered with brown pustules. The mischief was caused by *Puccinia Prenanthidis*.

J. C. Arthur§ has proved by experiment that the Æcidium of *Oxalis cymosa* is synonymous with *Puccinia Sorghii*, the rust of *Zea Mays*. He gives further notes on the occurrence of Æcidia on various species of *Oxalis*.

Infection Experiments with Uredineæ.‖—Fr. Bubak gives us a long account of these, and the results arrived at. He experimented with the rusts found on *Adoxa moschatellina*, and determined three different forms: an Æcidium of *Puccinia argentata*, with perennial mycelium; a Micropuccinia—*Pucc. Adoxæ*—also with perennial mycelium; and *Puccinia albescens*. Many of the experiments gave only negative results. He established that *Melampsorella Symphyti* was connected with an Æcidium on *Abies pectinata*, which is different from all those hitherto described on firs.

C. M. Gibson¶ has carried out a number of experiments, having for their object the testing of the behaviour of the rust hyphæ after entering a leaf. As a rule she chose plants that would not readily be infected by the rust spores which she used for experiment. The spore usually germinates, and the tube enters or attempts to enter the stoma, but if the host be unfavourable great differences of development take place: the hyphæ penetrate no further than the opening or persist until they reach the spongy tissue. In two or four days the hyphæ were dead, probably poisoned by some substance in the plant cells. The writer also gives details of inoculation with rusts on similar hosts that had been previously immune to attack. She describes the conditions under which they became liable to infection, and the action of the rust spores on these plants.

Distribution of Uredineæ on their Host Plants.**—P. Dietel repeats Klebahn's statement that, as far as our present knowledge goes, no rule can be formulated as to the selection of host plants by the heterœcious rusts. He then examines the matter, and endeavours to trace some general law of selection. He finds, for instance, that in the evolution of the species, that is, in its selection of new hosts, a more

* Ber. Schweiz. bot. Ges., xiv. (1904) p. 17. See also Bot. Centralbl., xcvi. (1904) pp. 385–6.

† Journ. Mycol., x. (1904) p. 228.

‡ Agric. Moderna, x. (1904) pp. 32–3. See also Centralbl. Bakt., xiii. (1904) p. 471.

§ Bot. Gazette, xxxviii. (1904) pp. 64–7. See also Bot. Centralbl., xcvi. (1904) p. 547.

‖ Centralbl. Bakt., xii. (1904) pp. 411–26.

¶ New Phytol., iii. (1904) pp. 184–91 (2 pls.).

** Centralbl. Bakt., xi. (1904) pp. 218–34

highly developed host than the one on which it already grows is selected by the parasite, and one of a more recent geological formation. He divides the Uredineæ roughly into two groups, the Melampsoraceæ and the Pucciniaceæ, the latter—the more recent in time—growing almost exclusively on Angiosperms. Three factors are important in influencing the selection by the parasite of new hosts: (1) the tendency of the fungus to enlarge the circle of hosts; (2) a corresponding condition of the protoplasm of both plants, so that the host may receive the parasite; and (3) the geological age of the host plants. The writer goes on to discuss the different genera of rusts, their probable age, and the course of their development on the different hosts. Some of these genera are confined to one family of host plants, others have attacked a large number. The effect of temperature is also considered of great importance in these changes.

Relationship of Macrophoma and Diplodia.*—The pycnidia of these two fungi were found growing in very close proximity on flower-bud spathes of *Cocos*. Julia I. Emerson has proved, by a series of cultures, that they are developmental forms of one fungus, and that the colourless *Macrophoma* spores are immature stages of brown two-celled spores of *Diplodia epicocos*. The cultures were commenced on agar, and continued on potato and coco-nut pith or bread.

Rotting of Cherries by Glœosporium.†—A disease of apples caused by a species of *Glœosporium* has been known for some time. A. Osterwalder describes the effect produced on cherries by *Glœosporium laeticolor*. The fungus appears on the fruits as small white pustules, which eventually cause brown spots, and the wrinkling and shrivelling of the cherry. The writer finds that the fungus can only penetrate the host through a wound, but once entrance has been gained it spreads rapidly through the flesh of the cherry. Systematic notes are given on several allied species of *Glœosporium*.

Leaf-disease of Ribes alpinum.‡—R. Laubert finds that this disease is caused by *Glœosporium variabile* sp. n. The leaves are irregularly marked with round dark-coloured spots, on which the fungus is found growing. Occasionally the fungus fruits on the green parts of the leaf.

Morphology of a New Cytospora.§—R. Laubert found a new species of *Cytospora* on half-dead gooseberry branches. The spores in the mass have a golden yellow colour. The perfect fruit form, probably a *Valsa*, was not found. A diagnosis of the fungus is given.

Disease of Potato.‖—V. Tubeuf gives an account of early-blight or eaf-spot disease which is caused by a Hyphomycetous fungus, *Macrosporium* = *Alternaria Solani*. On the same spots there appeared a *Cladosporium* and a *Sporidesmium*. Joh. J. Vanha¶ has made culture

* Bull. Torrey Bot. Club., xxxi. (1904) pp. 551–4 (1 pl.).
† Centralbl. Bakt., xi. (1903) pp. 225–6 (1 pl.).
‡ Naturw. Zeitschr. Land und Forstw., ii. (1904) pp. 56–8. See also Ann. Mycol., ii. (1904) pp. 463–4.
§ Centralbl. Bakt., xii. (1904) pp. 407–11 (1 pl.).
‖ Naturw. Zeitschr. Land. und Forstw., ii. (1904) pp. 264–9. See also Ann. Mycol., ii. (1904) p. 465.
¶ Tom. cit., pp. 113–27. See also Ann. Mycol., ii. (1904) pp. 465–6.

experiments with the two latter fungi, and finds they are stages of one plant. He describes the different forms of fructification, macrospores, pycnidia and conidia. The resting stage is characterised by the appearance of pycnidia and of small sclerotia-like, dark coloured clumps of hyphæ without any fructification.

Distribution of the Musk fungus (Moschuspilz).*—B. Schorler recounts the history of the various appearances of this fungus—a hyphomycete—in conjunction with other fungi, green algæ in various waters, usually where impurities have been added from factories, etc. Schorler considers it to be a form of *Nectria aquæductum*. It requires a certain amount of oxygen for its development, and thus it appears most generally where purification of the water has commenced by the renewed growth of green algæ.

Uromyces on Leguminosæ.†—Ernst Jordi has made many experiments on the forms of *Uromyces* to be found on various Papilionaceæ. For *Uromyces Fabæ* he distinguishes four biological forms confined to different hosts: (1) on *Vicia Faba* and *Pisum sativum*; (2) on *Vicia Cracca*, *Pisum sativum* and *Vicia hirsuta*; (3) on *Lathyrus montanus*; and (4) on *Lathyrus vernus*. He confirms the opinion of Plowright that *Uromyces Ervi* grows only on *Vicia hirsuta*. Other experiments were conducted with *U. Hedysari obscuri*, *U. Pisi* and *U. Astragali*. The latter he proved to be heterœcious; the æcidia grow on *Euphorbia Cyparissias*. He found also that *U. Astragali* includes three distinct species. Diagnoses of the various species are given.

Diagnostic Value of the Capillitium of Tylostoma.‡—L. Petri has examined and compared a large number of authentic specimens, and points out the characters of the capillitium that may prove of service in diagnosing the species. These characters are the colour of the filaments, their dimensions, articulation, and thickness of wall. An account is given of each species, and lists are drawn out recording in tabular form the facts noted. The capillitium of nearly all the species examined is figured.

Fruit Decay caused by Fungi.§—A. Osterwalder gives an account of the various filamentous fungi that attack stored fruit and quickly induce rottenness. In addition to the well known forms of *Penicillium*, *Monilia*, etc., he finds *Fusarium putrefaciens*, hitherto undescribed. The fruit perishes from the inside outwards, the tissue is dried up, and has a bitter taste. The writer describes fully the different cases of rottenness caused by other fungi, and he gives details of cultures with *Fusarium*.

Injury due to Frost followed by Fungi.‖—P. Sorauer enumerates a number of fungus forms, *Clodesporium*, *Alternaria*, *Ascochyta*, etc., that are to be found everywhere, but that do not attack plants unless they

* Abhandl. Naturw. Ges. Isis in Dresden, 1903, Heft i. See also Centralbl. Bakt., xi. (1903) pp. 352–4.
† Centralbl. Bakt., xi. (1904) pp. 763–95 (37 figs.).
‡ Ann. Mycol., ii. (1904) pp. 412–38.
§ Centralbl. Bakt., xiii. (1904) pp. 207–13, 330–8 (2 pls.).
‖ Landw. Jahrb., xxxii. (1903) pp. 1–68. See also Centralbl. Bakt., xi. (1903) pp. 362–3.

are previously injured; the injury in most cases being due to frost. He notes the localities and soils most favourable to such attacks. He advises early sowing as a preventive, and the selection of good strains of seeds.

Diseases of Sugar Beet.* — Fr. Bubak found in addition to *Cercospora Betæ*, another fungus on the leaves, *Ramularia Betæ*. The latter is entirely colourless, and forms its spores on the under side of the leaf. The author thinks that probably the *Ramularia* is closely connected with *Phyllosticta Betæ*. The two genera are often found on the same host plant, and are probably both stages of a pyrenomycete.

Brown Discoloration of Potato Leaves.† — J. Vanha has worked out the attack and subsequent destruction of potato leaves by a fungus which he describes under the name *Sporidesmium solani-varians*. The fungus can live as a saprophyte, but when it attacks the living host it causes brown spots, which increase quickly and destroy the whole leaf.

Disease of Figs.‡—G. von Lagerheim finds that the fungus which attacks figs is *Sterigmatocystis Ficuum*. It forms in the interior of the fruit small, black, dusty masses. Dates have also been attacked by the same fungus. The author gives the growth properties of the spores in different media.

Diseases of Cacao.§—Otto Appel and H. F. Strunk examined some plants of Cacao from Victoria, Kamerun, that had been killed by some obscure disease. On the branches they found a form of *Diplodina*, and, on the fruit, species of fungi belonging to four different genera, all of which they consider to be new. The material with which they worked was preserved in spirits or formalin. It could not certainly be stated that these fungi were harmful to the plant. They have been described by the writers for the information and help of Cacao planters and others.

Handbook of Technical Mycology.‖ — F. Lafar, with the help of forty-five other workers, is issuing a new and revised handbook. The first part deals with the general history, anatomy and classification of the Schizomycetes. It is written by Migula. The second part, by Lindau, deals in a similar manner with the Eumycetes; he discusses the form, membrane, plasma, nuclei, etc.

Fungus Flora of Hearth-rug.¶ — C. Crossland and J. Needham observed the different fungi that made their appearance on an old rug made of jute, wool, and cotton. They noted seventeen species in all, which grew in succession on the cloth. Only two out of the seventeen were humus species, the others had been observed commonly or exclusively on similar habitats. One new species was determined, *Libertella*

* Zeitschr. Zuckerind. in Böhmen, xxviii. (1904) p. 342. See also Centralbl. Bakt., xiii. (1904) pp. 468–9.

† Naturw. Zeitschr. Land und Forstw., 1904, p. 113. See also Centralbl. Bakt., xii. (1904) pp. 321–2.

‡ Separattrijck Svensk Farmaceutisk Tidskr., 1903, No. 18, 6 pp. See also Centralbl. Bakt., xii. (1904) p. 466.

§ Centralbl. Bakt., xi. (1904) pp. 551–7 (13 figs.).

‖ Handbuch der tecknischen Mykologie. Lief. i. (Jena, 1904). See also Bot. Centralbl., xcvi. (1904) pp. 354–5.

¶ Naturalist, Dec. 1904, pp. 359–63.

fusispora, which probably will be met with on twigs. The rug was watched until it was completely decayed.

The Detection of Arsenic by Growth of Penicillium.*—W. Hausman recapitulates the well-known facts as to detection of minute quantities of arsenical compounds by cultures of *Penicillium brevicaule* on the suspected substance, when a strong odour of garlic is given off by the fungus. The author finds that a member of the Actiniæ, *Aiptasia diaphena* possesses the same property, especially when it is grown in symbiosis with yellow algal cells.

BARBIER—**Agaricinées rares, critiques ou nouvelles de la Côte-d'Or.**
[Critical notes on many species of the larger fungi.]
Bull. Soc. Mycol. de France, xx. (1904) pp. 89–134 (1 pl.).

BRZEZIŃSKI, J.—**Einige Bemerkungen über die Krebs und die Gummikrankheit der Obstbäume, and Erwiderung** by **Aderhold.**
[A correspondence between the two scientists as to the cause of canker in fruit trees.] *Centralbl. Bakt.*, xii. (1904) pp. 632–40.

BUBAK, FR.—**Neue order Kritische Pilze.**
[The fungi described here for the first time were collected in Bohemia. There is one new genus, *Diplozythia*—probably the pycnidial form of *Ophiobolus*.
Ann. Mycol., ii. (1904) pp. 395–401 (21 figs.).

BUCHOLTZ, FEODOR—**Bemerkung über das Vorkommen des Mutterkornes in dem Ostseeprovinzen Russlands.**
[Notes on the occurrence of species of *Claviceps*, with a list of the host-plants.]
Correspondenzblatt des Naturf.-Ver. Riga. xlvii. (1904) pp. 57–64.
See also *Centralbl. Bakt.*, xcvi. (1904) p. 551.

CARLETON, M. A.—**Investigations of Rusts.**
[Additions are made to the life-history of some thirteen species of Uredineæ.]
U.S. Dept. Agric. Bull., lxiii. (1904) 27 pp. (2 pls.).
See also *Bot. Centralbl.*, xcvi. (1904) p. 552.

CHRZASZSZ, T.—**Zur Kenntniss des Hefewachstums in Mineralischer Nährlösung.**
[The influence of mineral salts on the growth of yeast.]
Centralbl. Bakt., xiii. (1904) pp. 144–9.

COHN, ERICH—**Ein Beitrag zum Vergleich der Kleinschen Hefe mit anderen pathogenen Sprosspilzen.**
[The writer insists on the distinction between Klem's yeast and other organisms with which it has been confounded.]
Centralbl. Bakt., Orig., xxxvi. (1904) pp. 369–79.

CROSSLAND, CHARLES—**Fungus Foray at Rokeby.**
[An account of fungi collected at Rokeby, in Yorkshire.]
Naturalist, 1904, pp. 329–42.

CUPINO, L.—**Un secondo contributo alla Flora Micologica della Provincia di Napoli.**
[There are recorded 57 species. One of them, *Phyllosticta Mimusopis*, is new.]
Malpighia, xviii. (1904) pp. 546–52.

" " **Fungi magnagutiani.**
[A list of fungi collected by Count Magnaguti in the districts of Manuta and Faenza.] *Tom. cit.*, pp. 553–8.

" " **Pugillus cryptogomarum canadensium.**
[A list of cryptogamic plants collected in Western Canada by Albert Hill, including a number of lichens.
Tom. cit., pp. 559–62.

* Beitr. Phys. und Path., v. (1904) p. 397. See also Ann. Mycol., ii. (1904) pp. 471–2.

Delacroix, Georges—Sur quelques Champignons parasites des Caféier.
[Notes on six different parasitic fungi that attack the coffee-plant.] *Bull. Soc. Mycol. France*, xx. (1904) pp. 142–51 (1 pl.).
See also *Bot. Centralbl.*, xcvi. (1904) p. 553.

" " **Rapport sur une maladie des asperges dans les environs de Pithiviers.**
[An account of disease caused by *Rhizoctonia violacea*.] *Bull. Mensuel Office renseignements agricoles*, 1903, 6 pp.
See also *Centralbl. Bakt.*, xiii. (1904) p. 463.

Ellis, J. B., & W. A. Kellerman—A new Phyllachora from Mexico.
[The fungus occurred on a shrub of the family Rhamnaceæ.
Journ. Mycol., x. (1904) pp. 231–2 (5 figs.).

Fairman, C. E.—Some new Fungi from Western New York.
[Diagnoses of seven new species of microfungi.]
Journ. Mycol., x. (1904) pp. 229–31.

Ferraris, Teodoro—Enumerazione dei funghi della Valsesia, raccolti dal Ch. Cav. Ab. Antonio Carestia (serie Terza), con Tav. ix.
[The species included in this list are nearly all microfungi; a few of them are new to science.] *Malphigia*, xviii. (1904) pp. 484–503 (1 pl.).

Hansen, Chr. Emil—Grundlinien zur Systematik der Saccharomyceten.
[The writer recognises six genera of Saccharomycetes, which he describes, with a note of the species belonging to each genus.]
Centralbl. Bakt., xii. (1904) pp. 529–38.

Heck—Vom Tannenkrebs.
[The writer discusses the attack of *Æcidium elatinum* causing Witches' Brooms on pines.] *Forstwiss. Centralbl.* (1903) Sept.–Oct.
See also *Centralbl. Bakt.*, xii. (1904) p. 319.

Henneberg, W.—Abnorme Zellformen von Brennereihefen.
[The formation of the peculiar form described depended on the concentration of the culture medium.] *Centralbl. Bakt.*, xiii. (1904) pp. 150–3 (1 pl.).

Hennings, P.—Die Galtung Aschersonia Mont.
[Murril has wrongly appropriated the name Aschersonia to a genus of Polyporaceæ. Montague created it for a genus of Nectrioideæ.]
Festschrift zu P. Ascherson's 70 *Geburtstage*, vii. (1904) pp. 68–72.
See also *Bot. Centralbl.*, xcvi. (1904) p. 386.

Herlitzska—Sull isolamento di un corpo glicolitico dal Saccharomyces cerevisiæ.
[The author names the ferment that he has isolated "Plasmozyme."]
Giorn. R. Accad. Med. Torino, 1903, Nos. 2, 3.
See also *Centralbl. Bakt.*, xi. (1904) pp. 412–3.

Hest, J. J. van—Quantitative Bestimmung der Hefenernte aus der Stickstoffaufnahme der Hefe und die Beziehung zwischen Alkoholbildung und Stickstoffaufnahme.
Wochenschr. Brauerei, xxi. (1904) pp. 1–3.
See also *Ann. Mycol.*, ii. (1904) p. 479.

" " **Beiträge zur kenntniss wilder Hefen.**
Zeitschr. Gesamte Brauwesen, xxvi. (1903) pp. 808–14.
See also *Ann. Mycol.*, ii. (1904) pp. 479–80.

Herzog, R.—Zur Biologie der Hefe.
[An account of the development of the yeast-cell, and the rate of increase.]
Zeitschr. physiol. Chemie, xxxvii. (1903) p. 396.
See also *Centralbl. Bakt.*, xi. (1903) pp. 228–9.

Hollrung, M.—Bericht der Versuchstation für Pflanzenkrankheiten in Halle.
[*Peronospore Schachtii* and *Rhizoctonia violacea* are recorded as diseases of beet.] *Zeitschr. der Deutsch. Zuckerind.*, 1904, p. 465.
See also *Centralbl. Bakt.*, xiii. (1904) p. 467.

HOLWAY, E. W. D.—**Mexican Uredineæ.**
[Diagnosis of new species.] *Ann. Mycol.*, ii. (1904) pp. 391–4.

INGHAM, W.—**Badhamia rubiginosa Rost. var. globosa n. var.**
[This species was first published in the *Journal of Botany* in 1904. The writer has now found it among gatherings from Yorkshire and North Wales as far back as 1878.] *Naturalist*, 1904, p. 362.

IWANOFF, K. S.—**Ueber die Wirkung einiger Metallsalze und einatomiger Alkohole auf die Entwickelung von Schimmelpilzen.**
[Poisonous effect of metals and alcohols on filamentous fungi.]
Centralbl. Bakt., xiii. (1904) pp. 139–44.

KEEGAN, P. G.—**The Chemistry of some common Plants.**
[Includes the chemistry of the common mushroom.]
Naturalist, 1904, pp. 345–6.

KELLERMAN, W. A., & P. L. RICKER—**New genera of Fungi published since the year 1900.**
[The list continued from the previous issues of the Journal.]
Journ. Mycol., x. (1904) pp. 229–50.

KRAUS, ALFRED.—**Zur Färbung der Hyphomyceten im Horngewebe.**
[Methods for detecting the presence of the fungus in hair, etc.]
Centralbl. Bakt., Orig., xxxvii. (1904) pp. 153–5.

LAUBERT, R.—**Beitrag zur Kenntniss des Glœosporium der roten Johannisbeere.**
[Different species of *Glœosporium* attack the red and black currants. These are described by Laubert.]
Centralbl. Bakt., xiii. (1904) pp. 82–5 (1 fig.).

LESCHISCH, MARIE—**Gärung und Atmung verschiedener Hefearten im Rollkulturen.**
[Fermentation and respiration of various species of yeast.]
Op. cit., xii. (1904) pp. 649–56; xiii. pp. 22–8 (3 figs.).

LINHART—**Die Peronospora-recte Pseudoperonospora-Krankheit der Melonen und Gurbien in Ungarn.**
[The author recounts the cases of the occurrence of this fungus in Hungary, Russia, and Austria.] *Zeitschr. Pflanzenkr.*, xiv. (1904) pp. 143–5.

LINDNER, P.—**Der Nachweis von Bierhefe in Presshefe mittles der biologischen Analyse und die Einführung eines bestimmten Hefetypus in der Preshefefabrikation.**
Zeitschr. Spiritusind., xxvii. (1904) p. 156.
See also *Ann. Mycol.*, ii. (1904) pp. 480–1.

" " **Zur Einführung von Presshefe vom sparrigen Typus.**
Tom. cit., p. 225. See also *Ann. Mycol.*, ii. (1904) p. 481.

LINDAU, G.—**Beitrag zur Kentniss eines im Wasser lebenden Discomyceten.**
[Description of *Humaria oocardi*, a water Discomycete.]
Festschrift zu P. Ascherson's 70 *Geburtstage*, xl. (1904) pp. 482–6.
See also *Bot. Centralbl.*, xcvi. (1904) p. 387.

M'ALPINE, D.—**Two new Fungi parasitic on Scale-Insects.**
[The species are *Microcera tasmanica* and *M. myrtilaspis*, both new to science.]
Dep. Agric. Mel. Victoria Bull., xiv. May, 1904.
See also *Bot. Centralbl.*, xcvi. (1904) p. 56.

MAGNUS, P.—**Einage Fragen betreffend die Nomenclatur der Pilze mit mehreren Fruchtformen.**
[The writer discusses the rules that ought to govern the naming of fungi that have several fruit forms.]
Festschrift zu P. Ascherson's 70 *Geburtstage*, pp. 431–8.
See also *Bot. Centralbl.*, xcvi. (1904) p. 389.

MASSEE, GEORGE—**A Monograph of the genus Inocybe.**
[The writer lays special stress on microscopic characters—cystidia, spores, etc.).
Ann. Bot., xviii. (1904) pp. 459–502 (1 pl.).

Meisenheimer, Jakob—Neue Versuche mit Hefepresssaft.
[On the nature of the zymase contained in the expressed juice of yeast.]
Zeitschr. physiol. Chemie, xxxvii. (1903) p. 518.
See also *Centralbl. Bakt.*, xi. (1903) pp. 229–30.

Morgan, A. P.—Pyrenomycetes scarcely known in North America.
[Diognoses of several new forms.] *Journ. Mycol.*, x. (1904) pp. 226–8.

Murrill, W. A.—The Polyporaceæ of North America. IX. Ionotus, Sesia, and Monotypic Genera.
[The new genera proposed by Murrill are *Lactiporus*, *Trichaptum*, and *Pogonomyces*.] *Bull. Torrey Bot. Club*, xxxi. (1904) pp. 593–610.

Oudemans, C. A. J. A.—Contributions à la Flore mycologique des Pays-Bas XX.
[A number of fungi are described for the first time, and the names of others corrected.] *Nederlandsch. Kruidkundig. Archief.*, serie 3, Deel 2 (1904) pp. 1077–1133 (pls. xi.–xiii.)
See also *Bot. Centralbl.*, xcvi. (1904) p. 390.

Pantanelli, E.—Zur Kenntniss der Turgorregulationen bei Schimmelpilzen.
[A description of methods and results in determining the turgescence of the cells of filamentous fungi.] *Jahrb. Wiss. Bot.*, xl. (1904) pp. 303–67.

Rettger, Leo F.—A contribution to the study of pathogenic yeasts.
[An account of a yeast that was the cause of an abscess.]
Centralbl. Bakt., Orig., xxxvi. (1904) pp. 519–28 (2 pls.).

Rick, J.—Fungi austro-americani exs. Fasc. 1.
[Descriptions of the species included in the fascicle. There is one new genus, *Pseudohydnum*.] *Ann. Mycol.*, ii. (1904) pp. 406–10.

Rostrup, E.—Norske Ascomyceten.
[A list of Norwegian fungi; 23 new species are described.]
Vidensk. Selskab. Skrifter. I. Math. Naturv. Kl., No. 4 (1904) 44 pp.
See also *Ann. Mycol.*, ii. (1904) p. 460.

Salmon, E. S.—On the identity of Ovulariopsis Pat. and Har. with the conidial stage of Phyllactinia Lév.
[The author has established the identity in a number of species.]
Ann. Mycol., ii. (1904) pp. 438–44 (1 pl.)

Saccardo, D.—Aggiunte alla micologia romana.
[A list of 100 species, of which a number are new.]
Stazione speriment. agar. ital., xxxvii. (1904) pp. 53–81.
See also *Ann. Mycol.*, ii. (1904) p. 460.

Semadeni, O.—Beiträge zur Kenntniss der Umbelliferen bewohnenden Puccinien.
[A very large number of experiments and the results obtained are given.]
Centralbl. Bakt., xiii. (1904) pp 73–81, 214–21, 338–52, 439–48.

Wehrner, C.—Der Aspergillus des Tokelau.
[A new species, *Aspergillus Tokelau*, that causes a skin disease.
Centralbl. Bakt., Orig., xxxv. (1904) pp. 140–6 (9 figs.).

Wender, N., & Lewin, D.—Studien uber die Triebkraft der Hefe. (Studies on the expansive power of yeast.)
Oesterr. Brennereizeit., ii. (1904) Nos. 7–9, 11–13.
See also *Centralbl. Bakt.*, xiii. (1904) pp. 458–9.

Wiehmann, H.—Notiz zur Lebensdauer der Kulturhefe. (Notes on the duration of vitality in yeasts.) *Allg. Zeitschr. Bierbraueri u. Melsfabrik.*, xxxii. (1904) No. 6.
See also *Centralbl. Bakt.*, xiii. (1904) p. 458.

Zehntner, L.—Rapport over de Werkzaamheden in Maart en April 1904. (Korte Mededeelingen van het Procistation voor Cacoa. II. Semarang-Soerabia. Van Dorp and Co. (1904) 20 pp.) (An account of fungus diseases of Cacoa in Java.)
Bot. Centralbl., xcvi. (1904) p. 409.

Zimmerman, A.—Untersuchungen über tropische Pflanzenkrankheiten (Erste Mitteilung). (An account of various fungi causing diseases of plants in East Africa.)
Ber. Land. Forstw. in Deutsch-Ostafrika, Bd. ii. Heft. 1, pp. 11–36 (2 pls). See also *Centralbl. Bakt.*, xii. (1904) pp. 315–6.

Lichens.

Observations on Endosaprophytism in Heteromerous Lichens.* A. Elenkin has been following out his researches on this subject in Lichens of the genera *Lecidea*, *Acarospora*, and *Endocarpon*. He traces the "nekrale zone" which consists of dead and living gonidia in the various Lichens examined. He finds cases where the fungus pierces the living algal cell. Mostly the hyphæ penetrate the disorganised or empty sheaths of algæ. He finds also occasionally hyphæ in unaltered gonidia. The author is unwilling to consider these hyphæ as haustoria; he thinks that these outgrowths induce the destruction of the gonidia the cell-wall of which has been gradually destroyed by a ferment.

In a previous paper† more particularly devoted to the subject of haustoria in the gonidial cells, he discusses the matter, and arrives at the same conclusion. He found *Lecidea atro-brunnea* a suitable Lichen for study. Both papers are in Russian.

ELENKIN, A.—**Notes Lichenologiques. Le détriment occasioné par les lichens à des arbres à feuilles aciculaires.**
[The writer thinks that the trees are killed by the enveloping foliaceous lichens.]
Extrait der Bull. Jard. Imp. bot. St. Petersbourg, iii. (1903) 6 pp. See also *Bot. Centralbl.*, xcvi. (1904) p. 409.

" " **Notice préliminaire sur la récolte des lichens pendant le voyage dans la Russie centrale en 1903.**
[The writer collected 300 species during his journey.]
Op. cit., iv. (1904) 10 pp. See also *Centralbl. Bakt.*, xcvi. (1904) pp. 409–10.

" " **Pilocarpon leucoblepharum (Nyl.) Wain., comme représentant des lichens épiphylles dans le Caucase.** (Russian.)
[The species grows in Europe on the branches and needles of Pines. In the Caucasus it grew on the leaves of the Box.]
Op. cit., iii. (1903) 8 pp. See also *Bot. Centralbl.*, xcvi. (1904) p. 410.

" " **La distribution des Lichens aux Saïan.** (Russian.)
[The writer gives the forms that are to be found at different elevations.] *S. A. T. XXXV. der Mittheilungen der St. Petersburger naturforschende Gesellschaft*, 1904, 8 pp. See also *Bot. Centralbl.*, xcvi. (1904) p. 409.

" " **Les espèces remplacantes (II.)** (Russian.)
[An account of the forms in Siberia that replace the forms common in Europe.]
Bull. Jard. Imp. Bot. St. Petersbourg, iii. (1904) 13 pp. (2 pl.) See also *Bot. Centralbl.*, xcvi. (1904) p. 409.

" " **Lichenes Floræ Rossiæ et regionum confinium orientalium. Fasciculus II.**
[An account of 50 lichens belonging to various genera, with critical notes on many of the species.]
Acta Petrop., xxiv. Fasc. i. (1904) p. 1–118.

FINK, BRUCE—**Further notes on Cladoniæ iii. and iv.**
[The writer deals in the two papers with *Cl. furcata* and *Cl. verticillata*.]
Bryologist, vii. (1904) pp. 53–8 (1 pl. and 2 figs.); pp. 84–8 (1 pl.)

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* Bull. Jard. Imp. Bot. St. Petersburg, iv. (1904) No. 2, 15 pp., 4 figs. and 2 pls. See also Bot. Centralbl., xcvi. (1904) pp. 392–3.

† S.A. Mitth. St. Petersburgen Naturf. Ges., xxxiv. (1903) 8 pp.

Schizophyta.

Schizomycetes.

Epidemic or Bacillary Dysentery.*—Firth finds that the so-called dysentery bacilli obtained from dysenteric excreta are of two types, the non-pathogenic and the pathogenic. The cultural features of the non-pathogenic type is its ability to split up maltose, galactose and mannite, forming acid but not producing gas, and also to produce indol. The pathogenic type does not possess these characters.

The non-pathogenic type should not be termed *B. dysenteriæ*; it belongs to a variety known as *B. typhosus simulans*, and differs from *B. typhosus* in not agglutinating with enteric serum, and its ability to produce indol.

The non-pathogenic "pseudo-dysentery" bacilli occur commonly in sewage and in most dysentery dejecta during the later stages of the disease, after the acute symptoms have passed; the true *B. dysenteriæ* are present chiefly during the early acute stages of the affection. The causative agent in the various cases of dysentery, among which the author includes the typical acute dysentery of camps, ileo-colitis, and the infective diarrhœas of infants and adults, is an organism belonging to the pathogenic type of *B. dysenteriæ*. The toxic substances elaborated by or contained in the bodies of these bacilli have a selective affinity for the mucous membrane of the cæcum and colon. He finds that, although the subcutaneous inoculation of these bacilli and the toxic substances into rabbits produce symptoms and intestinal lesions characteristic of epidemic dysentery in man, yet it is not possible by ordinary ingestion or by direct introduction into various parts of the alimentary canal, to produce intestinal lesions or general infection in these animals. He suggests that the epithelial lining of the intestinal tract of the rabbit has a high refractiveness to these bacilli. They produce dysenteric lesions in the monkey when administered with food.

Spore-production by Bacillus Anthracis and other Spore-bearing Bacteria.†—Selter finds that the most suitable media for the production of spores with aerobes are broth, agar, and these with the addition of 2 p.c. lactose. He finds that an addition of 5 p.c. glycerin to the medium has a inhibiting influence on spore-production, as also to a less extent has 2 p.c. glucose. Several repeated cultivations on glycerin-agar created an asporogenous strain of the organism. Spore-formation is affected by deficiency of nourishment, but only if the bacilli are at the height of their development; the greater the supply of oxygen the better for the spore-formation. Spore-formation of anaerobes is favoured by the addition of glucose or glycerin.

Bacteria of Flax "Retting."‡—The object of flax retting is to dissolve and soften the rind of the flax stalks, so that the bast bundles can be easily separated from the wood; it consists in the removal of the

* Trans. Path. Soc., lv. (1904) pp. 340–74.
† Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) p. 388.
‡ K. Akad. Wetenschappen, vi. (1904) pp. 462–80.

pectose, a compound of lime with a substance which is chemically closely related to cellulose, and which together with cellulose composes the cell-walls.

A. van Delden finds that the removal of pectose is effected by various micro-organisms, among which are the aerobic bacteria *B. mesentericus*, *B. subtilis*, and their allies, certain moulds, and especially an anaerobic bacterium to which he gives the name of *Granulobacter pectinovorum*, and the nearly related *Granulobacter urocephalum*.

These organisms secrete a special enzyme "pectosinase," which converts the pectose into pectine, and the pectine into various sugars, which undergo fermentation with the production of H, CO_2, and butyric acid.

Granulobacter pectinovorum is a long slender rod, which later becomes swollen at one end by an oval spore; grown in dilute malt extract anaerobically, it produces fermentation without the formation of butyric acid; with starch, inulin, mannite, erythrite and glycerin, fermentation could not be produced; with pepton and with dilute broth or albumen as a source of nitrogen, fermentation occurred in glucose, lævoluse, galactose, milk-sugar, and maltose, with a slight production of butyric acid; with ammonium salts as a source of nitrogen, fermentation cannot be produced with any of these sugars; proteids and gelatin are peptonised. Cellulose is quite unaffected by this organism, hence the flax fibre remains quite unchanged in the process of "retting."

Morphology and Biology of Bacillus Zopfii.*—Swellengrebel has isolated this organism from milk; he regards it as being associated with putrefactive processes. It is a very motile rod $2 \cdot 5\ \mu$ long with numerous flagella; stains by ordinary dyes and by the methods of Gram and Claudius. He is satisfied that spores are formed, having followed the phases of their development on agar plates. On gelatin plates the colonies have opaque white centres, with radiating offshoots of smaller transparent yellowish colonies. He never observed liquefaction of the gelatin; he only obtained a growth in a gelatin stab at a temperature of 22° C. On agar he distinguishes two forms of colonies, the one small, greyish white, with fine offshoots and surrounded by a transparent zone, as is described by Lehman and Neumann; the other resembling this, but of a denser appearance. Growth in bouillon varies according to the temperature; at room temperature it forms a sediment, the liquid is not clouded, and there is no pellicle; at 26° C. a pellicle is formed, but he never found the medium clouded; the reaction is alkaline; growth is equally good at 30° C. On potato it forms a greyish-white film. In milk it produces no coagulation and no change in reaction. In glucose and lactose broths it grew well; after 5 days he noted acid-production in both, especially with glucose; the broth was clouded and had a fœtid odour; he never observed any production of gas. The power to form indol is variable; a 7-day old culture at 26° C. in pepton solution (2 p.c.) gave a strong positive reaction. He

* Ann. Inst. Pasteur, xviii. (1904) p. 712.

classes the organism with *B. vulgare* and *B. Zenkii*, and gives the distinguishing characters.

Decomposition of Cellulose by Aerobic Organisms.*—Van Iersen Jnr., finds that cellulose can be made to dissolve by the action of denitrifying non-sporing aerobic bacteria if the supply of air is limited. Cellulose may be attacked, also, when the air supply is not limited, by certain widely distributed aerobic non-sporing bacteria, among which is the brown pigmented *Bacillus ferrugineus*. The destruction is especially strong in symbiosis with a yellow micrococcus, which is itself inert. He finds that the destruction of cellulose by moulds is due to an enzyme, to which he gives the name of "cellulase." He considers that one of the origins of the colour of humus is the pigment formed from cellulose by bacteria and moulds.

Bacterium that obtains its Carbon Food from the Air.†—M. W. Beijerinck and A. van Delden describe an organism which they have named *Bacillus Oligocarbophilus*; it obtains its carbon food from certain as yet undetermined carbon compounds of the air. Cultures on solid media and nutrient solutions containing soluble organic substances have failed, whereas pure cultures can readily be obtained on media not containing soluble carbon compounds. It was isolated by them from garden soil, inoculated in an alkaline mineral fluid medium, after 2–3 weeks incubation at 23–25° C.; it appeared as a white or slightly rose-coloured dry film, macroscopically resembling Mycoderma; it consists of thin, short rods, $0 \cdot 5$–$1\ \mu$ long; it grows slightly or not at all on ordinary media; it grows well on silica plates; it does not nitrify.

Variations in the Colours of Moulds and Bacteria.‡—T. Milburn finds that the colours of the conidia of *Hypocrea rufa* and *Hypocrea gelatinosa* depend on the reaction of the medium; with an acid reaction green spores are produced, yellow spores being formed on an alkaline medium. He finds that a well nourished mycelium has no fructification in the dark, but by an addition of excess of acid, or with a less nourishing medium, the formation of conidia commences. *Aspergillus niger* forms, besides the well known black colouring matter, a more or less abundant yellow pigment, which the author has also observed in the black spores; this yellow colour is very sensitive to light, and becomes grey and black after exposure for a few hours. *Bacillus ruber balticus* also has its pigment production influenced by the reaction of the medium, producing a violet coloration with an acid medium, and an orange-red colour when the medium is alkaline.

Bacillus helixoides, a bacillus that forms Colonies with Snail-like Movements.§—T. Muto (Tokio) isolated this organism from his own saliva. Two forms of the bacillus occur in the same colony. Those at the peripheral moving parts of the colony are oval truncated rods, 2–$4 \cdot 5\ \mu$ long and about $0 \cdot 64\ \mu$ broad, existing singly or two or three

* K. Akad. Wetenschappen, v. (1903) pp. 685–703.
† Tom. cit., pp. 398–413.
‡ Centralbl. Bakt., 1te Abt. Orig., xiii. (1904) pp. 257–75.
§ Op. cit., 1te Abt. Orig., xxxvii. (1904) pp. 321–5.

together, and occasionally forming threads. Those in the central stationary part of the colony are only about a quarter as long, and resemble oval cocci; they exist usually in pairs. The organism probably does not form spores, since it is killed after 15 minutes' heating at 60° C. It stains with the ordinary aniline dyes, but not by Gram's method. *B. Helixoides* is actively motile; but the bacilli in the water of condensation in an agar culture and in milk are non-motile, very adhering, and form threads; if these are transferred to salt solution, they at once exhibit active movement. They possess 8–10 flagella. This bacillus is a facultative aerobe. It grows best at about 30° C. Agar stab cultures produce no gas. Gelatin is not liquefied. The colonies are distinguished according to their movement as snail-like, tendril-forming, and cloud-like colonies. Detailed account is given of the cultural characteristics on various media; growth being especially bad in broth, pepton-water, and milk. Indol reation was not observed. It is not pathogenic for mice, rats, rabbits, guinea-pigs, dogs, or pigeons.

Nutrition of Bacterium Acaciæ.*—R. Greig Smith, who has already shown that when *Bact. acaciæ* and *Bact. metarabinum* are sown on saccharose-potato-tannin-agar, luxuriant slimes are produced, from which arabin and metarabin can be obtained, now records observations on the nutrition of *Bact. acaciæ*. This organism can produce gum readily in the presence of suitable nutrients; the best sources of carbon being levulose and saccharose. When subcultivated on sugar-free media, the power of forming gum is temporarily lost. Amides are the best nitrogenous nutrients. Some salts, such as alkaline citrate and succinate, are favourable. Sumach tannin assists the formation of slime on agar media. The optimum temperature is 17° C. Gum acacia has not a cellulose origin, but is formed from levulose and maltose. The flux produced by inoculating peach-trees with *Bact. acaciæ* is a metarabin gum. The host-plant can convert *Bact. acaciæ* into *Bact. metarabinum*, proving that the latter is a variety of the former producing an insoluble gum. This explains the uniformity of the gums from certain species of trees.

Bacterial Disease of Cauliflower.†—F. C. Harrison describes a disease of the cauliflower and allied plants, due to the action of *Bacillus oleraceæ*. The bacillus varies considerably in length (1–4 μ) according to the medium on which it is cultivated and to the host on which it is found. The ends are always rounded: it is usually single, but short chains occasionally occur. It possesses 7–13 peritrichous flagella. It does not form spores, is easily stained, but not by Gram's method. It grows well on most artificial media, the optimum temperature being about 30° C. It is a potential anaerobe, but grows better in the presence of oxygen. It produces acid; ammonia; hydrogen sulphide; a characteristic odour; and enzymes. Of these latter the most interesting is a cytase which has the power of destroying the cell-wall of various plants.

* Proc. Linn. Soc. N.S.W., xxix. (1904) pp. 217–52 (2 pls.).
† Centralbl. Bakt., 2te Abt., xiii. (1904) pp. 46–55, 185–98 (6 pls.).

Tobacco Wilt Disease.*—Y. Uyeda, who has studied the tobacco wilt disease, states that it is caused by bacteria which enter by the roots, the stomata, or through wounds. The bacillus is found in the affected parts in almost pure culture. The bacillus is 0·6–0·9 μ wide and 1–1·2 μ long. It usually has 8 flagella. It grows best at 32° C., and is a potential anaerobe. On gelatin the growth is slow, and the pellicles, white at first, gradually become black. In about five weeks the medium is liquefied. In glucose agar or glucose broth it produces gas, a little acid, and a rancid odour. It saponifies milk, and on potato produces a yellow pigment, which gradually turns brown. On agar the colonies are round and dirty white, while just beyond the medium is stained brown.

GRADWOHL, R. B. H.—**Importance de l'Examen bactériologique pratiqué sur les Cadavres.** *Ann. Inst. Pasteur*, xviii. (1904) pp. 767–78.

KUNTZE, W.—**Beiträge zur Morphologie und Physiologie der Bakterien.** (Contributions to the morphology and phsiology of Bacteria as exemplified in the case of *B. denitrificans agilis* (Ampola and Garino) and *B. oxalaticus* (Zopf). *Centralbl. Bakt.*, 2te Abt., xiii. (1904) pp. 1–12 (1 pl. and 1 fig.).

* Centralb. Bakt., 2te Abt., xiii. (1904) pp. 327–9 (3 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Koristka's large Model Microscope.†—F. Koristka's large model Microscope, IV. *a* (fig. 25) has a rectangular ebonite stage, 88 × 85 mm.,

Fig. 25.

and an Abbe condenser of N.A. 1·2. The substage apparatus is raised and lowered by means of rack and pinion movement, and is supplied

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† F. Koristka's Special Catalogue, Milan, November, 1904.

with an iris diaphragm. The stage can be fixed at any angle by means of a clamping handle, and the draw-tube is marked with millimetre divisions. Instead of a rectangular, the instrument can be supplied with a circular stage of 95 mm. diameter (fig. 26), the rotation axis of which

FIG. 26.

can be centred on the optic axis of the instrument by means of two binding screws. By means of these covers there is afforded a displacement of 6 mm. in every direction, so that this stage may be made to work as a travelling stage.

Differential Screw Fine Adjustment.* — W. Forgan had three "two speed" differential fine adjustments made upon Ashe's plan.‖ In the first, the quicker motion was $\frac{1}{50}$ inch, and the slower $\frac{1}{575}$ inch for each revolution; in the second, the slowest motion was $\frac{1}{1200}$, and in the third, $\frac{1}{200}$ for a revolution. As some slight hesitancy was observed

* Proc. Scot. Micr. Soc., 1903–4, p. 47.

‖ Journ. Quekett Micr. Club, ser. 2, viii. (1901) p. 131; Journ. R.M.S., 1902, p. 232, figs. 40–2.

when the motion was reversed, notwithstanding that the opposing spring was a strong one, a "single speed" lever motion was tried, the ratio of the arms of the lever being 8 to 1, the fine adjustment screw having 100 threads to the inch, with an opposing spring strong enough to require 7 lb. to move it. This was found to require a weight of only $\frac{3}{4}$ oz. to turn the head of the fine adjustment screw, and to work in a perfectly satisfactory manner.

(2) Eye-pieces and Objectives.

Spencer Objective.*—F. J. Keeley describes a Microscope objective of $\frac{1}{8}$ inch focus made in 1860 by Charles A. Spencer. It was recently necessary to take apart the back system for re-balsaming, when it was found to consist of five lenses, three of which were convex and two concave. One of these proved, on examination with polarized light, to be fluorite. This objective is historically interesting as illustrating the complex nature of the corrections adopted by Spencer at so early a date, as well as confirming the previous reports that he had appreciated the possibilities connected with the use of fluorite in securing superior colour corrections, and employed it for the purpose twenty years before it came into use abroad. The objective has an aperture of 142 to 152 degrees, according to position of the collar adjustment, which acts by the movement of the back systems, and it is unusually well corrected for colour. It resolves *Pleurosigma angulatum* sharply into dots with central light from mirror, and with oblique illumination resolves markings 76,000 to the inch.

H.—Construction of aplanatic combinations of lenses, with or without achromatism. *English Mechanic*, lxxx. (1904) pp. 252–3, 321–2, 340, 406–8.

MERLIN, A. A. C.—Microscopical high powers and deep eye-pieces.

[The writer says that if a given objective capable of affording a really clear, brilliant, and well-contrasted image under a × 12 ocular when a large solid illuminating cone is used, it may be employed, if necessary, in conjunction with the deepest eye-pieces, so as to give results just as satisfactory as would be attainable with a higher power objective of equal N.A. combined with a shallow eye-piece. *Tom. cit.*, p. 455.

VILLAGIO—Ditto. *Tom. cit.*, p. 384.

(4) Photomicrography.

Photomicrography with the Aid of Ultra-Violet Light.†—Text-books of science, as a rule, explain microscopic vision with the aid of rays. This elementary explanation does not fix any limit to the possible magnification, but as long as we have not to deal with dimensions which are comparable to the wave-length of light, it does not bring us into conflict with observed facts. But we reach the limit of resolution when the distances between the lines of the object are less than half a wave-length of the light with which we illuminate the object. The theory which Helmholtz advanced for self-luminous objects, and Abbe, about the same time, for illuminated objects, regards the microscopic images as diffraction phenomena; and this theory, some points of which Dr. Glazebrook has recently cleared up, also indicates the way in which

* Proc. Acad. Nat. Sci., Philadelphia, lvi. (1904) p. 475.
† Engineering, lxxviii. (1904) p. 760.

further resolution may be procured. We ought to work with light of very small wave-length. Since the wave-length is determined by the quotient $\lambda = \frac{V}{N}$, the velocity of light divided by the number of vibrations, two ways seem to be open in order to obtain a smaller λ. We may either decrease the velocity of the light, or increase the number of vibrations. The first can be accomplished by immersing the object in a liquid of high refractive index—glycerin, balsam, salt solution, etc. The method is applied to a certain extent, but does not carry us much further. The second method illuminates the object, not with ordinary white light, but with violet vibrations of higher frequency. It was first proposed by Amici, and is also used. But the intensity of the violet light is very feeble, or, rather, the eye is not very sensitive to violet rays. In photomicrography the second objection does not count, but the feeble intensity remains a drawback. A. Kohler, of Jena, has therefore tried ultra-violet light, notably the rays given out by electric sparks passing between cadmium electrodes. These rays, of wave-length 275 $\mu\,\mu$, have a high intensity. Dr. Kohler described his new camera-microscope, which has been constructed by the Zeiss Glas Werke, of Jena, before the Breslau meeting of the Naturforscher-Versammlung. The lenses of this Microscope are made of crystal and of fused quartz; they need only be corrected for spherical aberration, because no chromatic aberration has to be guarded against when monochromatic light is used. As the ultra-violet light is invisible, however, an artificial eye has to be combined with the Microscope for focussing and adjusting. This artificial eye consists of optical parts made of crystal, and of a retina made of fluorescent glass, which responds to ultra-violet rays. The observer examines through a lens the image thrown on this artificial retina. The instrument can, indeed, also be used for subjective vision by ultra-violet rays, and for this purpose magnesium light, of wave-length 280 $\mu\,\mu$, is still more suitable than the cadmium light. But the fluorescent light is injurious to the eye, and the finest detail can only be studied by photography. Yet the fluorescence helps in bringing out further detail. Dr. Kohler also immerses his specimens—so far, mostly organic tissues—in a mixture of glycerin and water, or in salt solution, of which physiologists make large use. The ultra-violet rays at once show differences in the structure, which, hitherto, staining had alone revealed. Thus the horny portions of the epidermis, the membranes of plant cells, and other parts, are more or less impermeable to ultra-violet rays, so that other advantages are realised in addition to the increased resolution. It would not be surprising if ultra-violet illumination should also render good service in metallography.

Three-Colour Photography.*—Chapman Jones gives the following résumé of two processes of colour photography.

König's Three-Colour Process.—This process, only recently published, has attracted a good deal of attention, and deservedly so, for it not only illustrates a new principle as applied to the purpose of colour photography, but has been worked out by its author to a successful

* Knowledge, i. (1904) pp. 285–6.

issue. Whether or not it will be found to fulfil the conditions necessary to establish itself as a standard or commercial process, only time can prove. It is a triple film method, but differs from those previously proposed, in that each colour is printed out by light.

Many of the organic dye-stuffs yield on reduction colourless or leuco-derivatives, which can be oxidised to reproduce the original colour with more or less facility, and exposure to light generally facilitates this oxidation. By choosing a dye of a suitable colour, and one that yields a leuco-derivative of sufficient stability to withstand the necessary operations and yet is sensitive enough for practical printing purposes, it is obvious that the colour may be obtained directly by exposure to light under the negative, and the necessity for a relief produced by the chromated gelatin process, or any similar indirect method of getting the required distribution of the colour, is obviated.

These leuco-derivatives were found to be useless by themselves or in an inert film, as they then gave only poor and flat images, but the presence of a nitric acid ester was discovered to overcome this difficulty. Pyroxylin being an ester of nitric acid a collodion film is employed, and mannite nitrate is very suitable for further augmenting the sensitiveness. The removal of the excess of the leuco-derivative after exposure was at first a difficulty, as ordinary solvents and acids were found useless for the purpose. But monochloracetic acid is effective, and it is used as a 10 p.c. solution.

The process consists in coating a suitably surfaced paper with a 1½ p.c. collodion, to which the leuco-derivative and other desirable materials have been added, exposing under the appropriate negative until the colour is sufficiently intense, fixing in the chloracetic acid solution, washing, and dipping into a gelatin solution that contains chrome alum, and drying. The print is again dipped into the gelatin solution and dried to effectively protect the collodion film during the application of the collodion that is to furnish the second colour. This routine is repeated for the second colour, and again for the third, and the print is finally varnished.

The method of judging when each colour is correctly printed is not very clear, as it seems impossible to adjust the depth of tint of the films that are sealed up by the subsequent coatings. The process is apparently rather tedious, as there are three collodion films, six gelatin coatings, and a final coating of varnish to dry. The obvious objection to the number of films because of their combined thickness is probably invalid, as the collodion and the gelatin solution used are weak, and the films they give correspondingly thin. A real difficulty I should have expected to be due to the action of the chloracetic acid on the gelatin films under the collodion film that is being subjected to the fixing operation, but doubtless this possibility has received attention.

Lumière's Starch Method of Three-Colour Photography.—This process, which was described about six months ago, contrasts very emphatically with König's method in the simplicity of the necessary manipulation. No colour-screens or filters are needed, there are no films to stain, no colours to produce of the correct intensity to match one another, no separate negatives with subsequent printings, but merely one exposure,

ordinary development, and then, instead of fixing, the silver image is dissolved out and the remaining silver salt reduced to the metallic state. But if the work of the photographer himself is simple, it is because of the complex character of the prepared plate; and presumably it is the difficulties of manufacture that have led to the delay in putting the prepared plates on the market. The plates are made by selecting starch granules of from 15 to 20 thousandths of a millimetre in diameter, staining quantities of them red, green, and violet respectively, drying them, mixing them so that neither colour predominates, but that the whole presents a neutral grey tint, and spreading the mixture on glass one layer thick. The interstices are filled in with a fine black powder, and the layer is fixed and protected by a coat of varnish. On this is put a film of suitably colour-sensitised emulsion. Exposure is given through the glass, and the subsequent treatment of the plate is as described above. The dyed starch granules form an irregularly grained three-colour screen, which serves the double purpose of taking and viewing.

It is easy to describe such a process, but besides the obvious mechanical difficulty of preparing the plates, there must be many compromises made before the result can be passably satisfactory. The best three colours for the exposure are not the best three for viewing the picture, but in this case they have to be the same. If the stained starch granules are mixed to the most neutral tint possible, it appears that a perfectly orthochromatised sensitive film would be necessary. The imperfections of the film in this matter must be neutralised as far as possible. Indeed, the difficulties of which the photographer is relieved have to be overcome by the manufacturer, and in this particular case they are so many and complex that if it had not been stated that results have been obtained in the manner described, we might very well doubt the possibility of it.

Photomicrography and Photomicrometry.*—J. Thompson employed a fixed magnifying power (say 1000 diams.) for photographing the object to be measured. This is obtained by using an oil immersion $\frac{1}{12}$ with a certain eye-piece, a fixed tube length, and screen distance. A sheet of paper is ruled in squares. This is photographed by an ordinary camera, and reduced until the squares measure 1 mm. on the negative. This negative is printed on the same positive as the photomicrograph; a direct measurement can therefore be made, because each mm. represents a micron magnified 1000 times. Other fixed magnifying powers are treated in a similar manner.

MATHET, L.—**Sur la reproduction des objets difficiles par la photomicrographie.** (A series of articles on the photomicrography of difficult objects.)
Rev. Sci. Photographiques, i. (1904) pp. 18–22, 48–53, 117–22, 176–80, 231–4 (23 figs.).

(5) Microscopical Optics and Manipulation.

Aperture Table.—It will be noticed that the limit for resolving power for white light in the aperture table, printed upon the fly-leaf of this

* Proc. Scot. Micr. Soc., iv. (1903–4) p. 44 (pls. iii.–vi.).

Journal, has been altered. Mr. Gifford's measure of λ for white light, viz. $0 \cdot 5607\ \mu$ has been substituted for that hitherto used, viz. $0 \cdot 5269\ \mu$ (line E). In the calculation the new metrical conversion table "for same temperature" was employed.

Resolution of Amphipleura Pellucida.* —C. Mostyn has resolved the transverse striæ on the *Amphipleura pellucida* with a water immersion $\frac{1}{12}$ N.A. 1·18, by means of superstage illumination, simply obtained by reflecting sunlight with the mirror turned up above the stage. The author is able to obtain an "ink-black" ground by this means, and observes that light from an $\frac{1}{2}$-in. paraffin wick is not sufficiently powerful for this kind of superstage illumination.

Ultramicroscopic Observations on the Decomposition of Sulphur from Thiosulphuric acid and of Selenium from Selenic acid.†—The investigations of Siedentopf and Zsigmondy with ultra-microscopical particles suggested to W. Biltz that, although the measurements of so-called "molecular dimensions" are somewhat beyond the limits of resolution, yet the observer's methods might be usefully applied to the investigation of certain cases of chemical composition and decomposition. He considers that (1) the ultramicroscope draws a sharp distinction between completely homogeneous (or "optically empty") solutions and those which appear turbid through a more or less fine suspension of minute particles: the diagnosis of so-called colloidal solutions being thereby simplified; (2) that it lends itself to a more accurate study of certain processes by which a heterogeneous medium is formed out of one originally homogeneous. He has examined the decomposition of thiosulphuric acid into sulphurous acid and sulphur ($H_2S_2O_3 = H_2SO_3 + S$), and the conversion of selenic and sulphurous acids into selenium and sulphuric acid ($H_2SeO_3 + 2H_2SO_3 = H_2O + Se + 2H_2SO_4$). Great difficulty was experienced in freeing the reagents, especially distilled water, from dust, but eventually success was attained. It was found that india-rubber couplings had to be avoided owing to partial solution. Experiments were also performed with proper mixtures of sodium thiosulphate and oxalic acid. Observations were made at suitable time-intervals, and several tables are given recording the growth of the particles and their colour-changes. In some cases the growth seems to be continuous, in others discontinuous.

Colours in Metal Glasses and in Metallic Films.‡—J. C. Maxwell Garnett seeks to explain the phenomena observed by Siedentopf and Zsigmondy by proving that the metal particles observed in gold glass are spherical in shape when the diameters are less than 10^{-5} cm. The fact that such particles are spherical throws light on the manner in which metals crystallise out of solution, the particles taking first a spherical form under the influence of surface tension, and later, when they become too large for the forces of surface tension to overcome the

* Knowledge, i. (1904) p. 307. An interesting question arises from this note. How does light of an obliquity greater than the critical angle get into the slide?—ED.

† Nachrichten Königl. Gesell. wiss. zu Göttingen, (1904) pp. 300-10.

‡ Proc. Roy. Soc., lxxiii. (1904) pp. 443-5.

crystallic forces, becoming amenable to the latter. He also shows that every transparent medium containing metal spherules, so that the average distance between two neighbouring spheres is considerably less than a wave-length of light, has a perfectly definite colour by transmitted light depending only on the optical constants of the metal of which the spheres are made, on the refractive index of the substance in which they are imbedded, and on the quantity of metal, but not on the size or distance apart of the spheres. It results that the presence of metal spheres accounts for the optical properties of gold ruby glass, and that the irregularities in the effects of colour and polarisation, sometimes exhibited by gold glasses, are due either to excessive distance between adjacent gold particles or to excessive size of such particles—the latter, however, involving the former. The author found that this regular colour can be produced in a colourless metal glass containing the metal in solution (which is the state in the manufacture of gold or copper ruby glass before the second heating) by the β-radiation from radium. The author also investigates the optical property of media built up out of metal spheres so that the volume of metal may have any value between zero and unity, instead of remaining very small as in metal glasses. He thus arrives at an explanation of the changes in colour of gold and silver films observed by G. T. Beilby, and of potassium and sodium films deposited on the insides of exhausted glass bulbs.

Construction-Principle of an Optical Apparatus for obtaining very Large Magnifications [The Diastoloscope].*—M. C. Chabrié has investigated the question whether, instead of the ordinary mode of obtaining an image geometrically like the object, it would not be more advantageous to produce images, deformed but highly enlarged, and then afterwards, by an inverse geometrical construction made on paper to a suitably selected scale, reconstruct the objects in their true proportions. His method depends upon the effect of viewing an object (a disc) through a crystal in the shape of a right cone with an accurately circular base. The cone-axis is arranged perpendicularly to the plane of the object (fig. 27). The image projected on a screen is found to be an annulus, whose centre is the point where the cone-axis meets the screen. The point on the image immediately under the apex of the cone is refracted into the outer circumference of the annulus, and other points in the neighbourhood of that point are projected into the inner neighbourhood of that outer circumference. The magnification will be the ratio of the image-circumference to the object-circumference. As the magnification of the centre point of the object becomes infinite, it will be readily understood that points near it will be very highly enlarged. It will also result that points on same concentric *circumference* of the image will have equal magnification, and that, therefore, if a region of the object between two points is to be examined, the object must be moved so as to bring these points on to the same circumference in the image. The object may of course be considered as composed of concentric, equidistant zones, whose common centre is the intersection of the cone-axis

* Comptes Rendus, cxxxviii. (1904) pp. 265–8, 349–51, 560–3, 656 (14 figs.).

with the object-plane; let these be numbered, mentally, 1, 2, 3, 4, *from* the centre (fig. 28). In the same way let the image be similarly divided into the same number of concentric and equi-distant zones, 1, 2, 3, 4, *towards* the centre (fig. 29): then the zones bearing the same number will correspond. If, also, object and image be divided up by radii at equal angular distance, then the object-intersection of a zone of a certain number with a radius of any number will correspond to the image-intersection of zone and radius of similar numbers. If the image be received on a glass plate engraved with such a system of circles and radii, the object can then be reconstructed. The author shows that the scale of magnification is a hyperbola, which can be easily drawn and used as a scale of reference. He recommends that the image be viewed

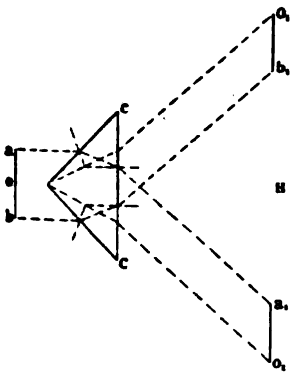

FIG. 27.

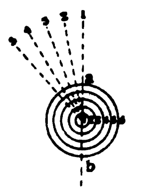

FIG. 28.

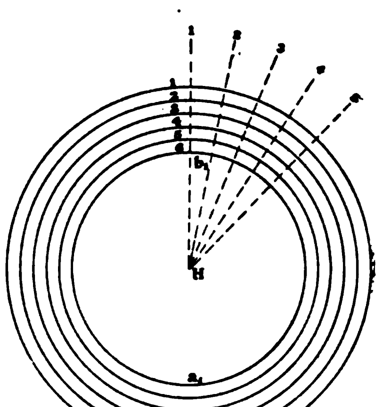

FIG. 29.

through a second cone of the same material of more obtuse vertical angle than the first cone: these two cones are mounted in sliding-tubes so that the distance between them may be varied; and the whole is applied to a Microscope in place of the usual ocular. The Microscope, having an objective in the usual way, is introduced into the bottom of a camera, and arranged so that the objective image is sharply focussed on a ground glass plate. This image could be photographed. The diastoloscope is then applied. The author hopes to realise magnifications of 5000–6000 diameters. He gives some specimens of his results with diatoms.

F. R. M. S.—**Amphipleura Lindheimeri.**

[The writer states that he has counted 76,000 transverse and 65,000 longitudinal striæ to the inch upon this diatom in a Watson's styrax slide.

English Mechanic, lxxx. (1904) p. 455.

HUNTER, J.—"**Cross**" **formula.** *Proc. Scot. Micr. Soc.*, iv. (1903–4) pp. 49–51.

(6) Miscellaneous.

CZAPSKI, SIEGFRIED—**Grundzüge der Theorie der optischen Instrumente nach Abbe.** Second edition, edited by O. Eppenstein and M. von Röhr, 490 pp., 176 figs. J. A. Barth, Leipzig, 1904.

ZEISS, CARL—**Die Bilderzeugung in optischen Instrumenten, vom Standpunkte der geometrischen Optik.** By the Scientific Staff of Carl Zeiss's Works. Edited by M. von Röhr, 558 pp., 133 figs. J. Springer, Berlin, 1904.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Diagnostic Media for the Study of Bacteria.†—G. Marpman describes the uses and methods of preparing various media for differentiating bacteria according to the products formed by the growth of the rganism. The production of acids or alkalies is indicated by using lacmus gelatin or chalk gelatin; reducing action is detected by lacmus gelatin or "Rhodan-Eisen" gelatin; sulphuretted hydrogen by lead gelatin; sulphur and sulphates by gelatin containing nitroprusside of sodium; carbonic acid by chloride of calcium gelatin; the formation of aldehyde is demonstrated by "Malachit Sulfit" gelatin; the presence of agglutinins is shown by safranin gelatin; and silver gelatin, poured into specially devised yellow glass petri dishes, is used to detect the formation of toxins, antitoxins, agglutinins, coagulins, etc.

Detection of Bacillus Enteriditis Sporogenes in Water.‡—R. T. Hewlett recommends the following method. Into boiling tubes, 40 c.cm. of milk are introduced; the same are plugged and sterilised. At the time of using, the tubes are boiled in a water-bath for a few minutes to expel air, and 60 c.cm. of the water to be examined are added. The wool plugs are now replaced by a cover of two thicknesses of sterile filter-paper kept in place by a rubber band, and the tubes are then heated at 80° C. for 10–15 minutes, and incubated anaerobically at 37° C. in a Bullock's apparatus, or in a stoppered museum jar of suitable size containing alkalin pyrogallic solution. By using a dozen tubes, 700 c.cm. of the water can thus be examined.

Plate Culture of Anaerobic Bacteria.§—The apparatus described by O. Berner consists of a flat vial with parallel faces, to one side of which is fused a glass cock. The nutrient medium, to which has been added some methylen-blue to indicate the absence of oxygen, is poured into the vial, the neck of which is closed by a wool plug, and the whole is boiled in a vessel of water until the blue colour begins to disappear. The wool plug is now replaced by a perforated rubber stopper, provided with a short glass tube and rubber tubing. Hydrogen is then passed into the apparatus until the blue colour has entirely disappeared; the vial is taken out of the water, the neck now closed with

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Zeitschr. angew. Mikr., x. (1904) pp. 169–74.

‡ Trans. Path. Soc., lv. (1904) p. 123.

§ Centralbl. Bakt., 1te Abt., xxxvii. (1904) pp. 478-80 (1 fig.).

a solid rubber cork, and the glass cock turned, and the whole set aside to cool, and if solid medium to solidify. When the medium is inoculated the vial is held neck downwards, the rubber cork is removed, hydrogen is conducted through the glass cock; and after inoculation, it is corked again without any air having been let in.

Isolating Bacillus Typhosus from the Blood and Organs after Death.*—By the method devised by Fraenkel and Simmonds the spleen is incubated for 24 hours, and the bacilli can then be readily shown histologically. For cultivation from the blood, 10–25 c.cm. are distributed on four to six plates of glycerin agar. This medium is preferred to Loeffler's serum, as it is transparent, is not liquefied, and keeps well.

Bacteriological Examination of Water in the Atlantic Ocean.†Otto and Neumann, during a voyage from Europe to Brazil, made a number of examinations of sea water taken at different depths and at different distances from the land. They found that the numbers of organisms were less in the high sea than nearer to shore; their results in mid-ocean at a depth of 5 metres show a maximum of 120 and a mean of only 60 germs per cubic centimetre. The fact that the numbers were often less at the surface and slightly below it than at a depth of 50 metres, they attribute to the disinfecting action of the sun's rays. The greater numbers found at certain depths may be explained by the presence of deep currents. Their plates showed Coli-like bacilli, Fluorescentes, Proteus-like liquefying organisms, sometimes white and yellowish non-liquefying colonies of rods; occasional vibrios and moulds.

They devised a special collecting apparatus that would act at definite depths and under the varying conditions of the sea, and the rate of travelling of the ship. This consists of a copper cylinder firmly bound to a rope line at the end of which is a 30 kilogrm. lead weight; the cylinder is provided above and below with a 6-holed brass plate, which is closed by means of rubber plates held fast by screws. At the side there is an opening by which the collected water can be let off. When the apparatus is lowered into the depth, the rubber plates will be raised and the water rushes in through the cylinder; on raising by pulling on the line, the resulting enormous pressure forces down the rubber plates and closes the openings of entry and exit, and the water has been collected at the desired depth. To determine the exact depth at which the sample was collected, an inverted test-tube lined with chromate of silver was fixed to the line; the red of the chromate is changed to white from below upwards, according to the height to which the sea water has entered the tube, and this is dependent on the pressure existing at the depth. With this instrument a scale of true depths was made.

Isolating Tetanus Bacillus from the Spleen.‡—Creite states that broth cultures, inoculated with portions of the excised wound and

* Centralbt. Bakt., Ref. 1te Abt., xxxv. (1904) p. 654.
† Op. cit., 2te Abt., xiii. (1904) pp. 481–9.
‡ Op. cit., 1te Abt., xxxvii. (1904) pp. 312–14).

incubated anaerobically, showed the presence of typical Tetanus bacilli with spores after 48 hours. Portions of the spleen, taken at the autopsy, were inoculated into a guinea-pig, which died with symptoms of Tetanus (coverslip preparations from the local lesion showing typical bacilli with spores). Broth cultures, inoculated from the local lesion and incubated anaerobically, showed the presence of Tetanus bacilli associated with streptococci and staphylococci. In three other cases of Tetanus all attempts to isolate the organism from the spleen, cerebral fluid, heart blood, and bone marrow gave negative results. He refers to the cases of Oetlingen and Zumpe, Nicolaius and others, where the Tetanus bacillus was isolated from the organs of the body.

Varieties in the Growth of Bacillus Pyocyaneus on Nutrient Agar.*—Hinterberg and Reitman find that there are differences in the growth of this bacillus on nutrient agar, according as the medium contains more or less water, and has a moist or dry surface. They give details of their methods for obtaining nutrient agar of various concentrations, and the technique of making moist or dry surfaces to the medium in the Petri dishes. When grown on weak moist agar, they find that the colonies of *B. pyocyaneus* are smooth and shining, almost fluid, of a blue-green colour, and with iridescent margins; they spread over the entire surface of the medium; and are most easily removed by the platinum needle.

Grown on dry and concentrated agar, the colonies are scanty, of a pale-green colour, often appearing as if etched on the surface; the centre of the colony is somewhat gelatinous, the margins slightly wrinkled; they hardly extend beyond the inoculated surface, and are so firmly attached to the medium that it is difficult to remove the growth with a platinum needle. Coverslip preparations were made and stained by Van Ermengem's method. Those made from the moist agar 24 hours' old colonies, showed only bacilli with polar flagella. Those from the dry agar colonies of the same age, showed a spider-web network of very fine threads, stretching between clumps of bacilli, lying among them a few bacillary bodies with indistinctly outlined capsules, and some free flagella.

They found that if the concentration of the medium is carried too far, the bacilli cease to grow well; they are smaller and stain feebly; and it was harder to obtain a clean preparation, since portions of the medium were always taken away with the culture. They consider that the network of threads, which are seen in the stained preparations made from cultures grown on agar of high concentration, is produced by portions of stained medium, which have become included in the emulsion made on the coverslip. The bacilli grown on the moist weak agar can readily move over the surface, and, moreover, they need to do so, and they accordingly produce motile organs. The same organism, grown on a rich medium with a dry surface, can move less easily, but finds sufficient nourishment in its immediate vicinity, and grows roots.

Cultivation and Staining of Amœbæ.†—W. E. Musgrave and M. T. Clegg, who have been studying the subject of amœbiasis for

* Centralbl. Bakt., 1te Abt. xxxvii. (1904) pp. 169–77.

† Publications Bureau Gov. Lab., No. 18, part i. Manila (1904) 85 pp., 35 figs.

some years, especially in relation to human disease, recommend that after the administration of a saline cathartic, the examination should be made from the fluid portion of the stools. They significantly point out that the diagnosis of amœbæ should never be made unless they are in a motile state, for even with typical resting or encysted forms mistakes may occur. The stock medium for cultures used by the authors is composed of agar 20 p.c., sodium chloride 0·3–0·5 p.c., extract of beef 0·3–0·5 p.c. The finished medium should have an alkalinity of 1 p.c. to phenolphthalein. This is obtained by starting with an initial alkalinity of 1·5 p.c.

The stock medium was varied by diminishing the amount of salt and beef extract, or by the addition of a minute amount of peptone. Attempts to obtain pure cultures were always negative or doubtful, and the authors' results were obtained from symbiotic cultures of amœbæ and bacteria. Pure bacterial cultures were employed, and much difference was found in the adaptability of particular bacteria for the purpose in view. The medium, made into plates in the usual way, was inoculated with the bacterial culture by smearing a loopful in concentric circles on the surface of the agar, and then depositing some of the amœba culture in the middle of the innermost bacterial circle. In from 24 to 72 hours the protozoa will have passed one or more rings, and from such locations may be taken for transplantings.

Transplantation of a single amœba is effected by the following ingenious device. Examine the surface of the plate, and locate an isolated amœba in the centre of the field of a low-power lens. Turn on a dry high-power lens, and lower it until it touches the surface of the medium. Raise quickly, and examine with low-power lens whether the amœba is still present, or has been picked up by the high-power objective. If it has been, rub the ace of the objective gently over that of a new plate. In this way symbiotic cultures from a single amœba may be obtained.

Amœbæ show marked preference for certain kinds of bacteria, but this selectiveness may be due possibly to environment. The authors had most success with the colon group.

Amœbæ do not develop below the surface of solid media unless in association with a liquefying organism, and then do not extend beyond the liquefied area. The growth and spread of amœbæ over the surface of plate cultures is quite rapid, and they seem to follow the path of the bacteria. In relation to their pathogenicity the authors do not attach much importance to the size, which has been stated by various writers to vary from 5 to 50 μ. The optimum temperature of the amœbæ, studied by the authors and obtained from different sources, is room temperature. Growth was much less luxuriant at incubator and ice-box temperatures.

For staining living amœbæ the authors recommend a dilute solution of neutral red, which should be run under the cover glass. For staining permanent preparations of amœbæ from cultures they praise Wright's modification of the Romanowsky method, the technique being the same as that for blood films.

The authors also notice the following procedures: (1) Zorn's method consists in mixing a few cubic centimetres of fæces with 3 or 4 volumes of a solution consisting of 15 parts of 1 p.c. chromic acid and 3 parts of

1 p.c. osmic acid. After shaking for 10 minutes the mixture is centrifuged, and the deposit mixed with 5 volumes of 25 p.c. Beale's carmin solution. After half-an-hour this is again centrifuged, and the deposit washed in a weak solution of the same carmin and mounted on glycerin, or dehydrated and mounted on balsam. (2) Doflein's methods. This writer suggests fixation of the material in one of the following solutions: A. Saturated aqueous solution of sublimate 100 parts, alcohol 50 parts, acetic acid 5 parts. B. Picric acid 2 parts, alcohol 50 parts, acetic acid 5 parts.

Doflein makes a film of the protozoa on a slide, or handles them in bulk imbedded in paraffin, and treated as sections.

STULER—New methods for anaerobic cultures and anaero-cultures.
Centralbl. Bakt., 1te Abt., xxxvii. (1904) pp. 298–307.

(3). Cutting, including Imbedding and Microtomes.

New Imbedding Bath.*—The imbedding bath recently brought out by the Cambridge Scientific Instrument Company is similar to the

FIG. 30.

gas-heated baths made by the same firm, in which a gas regulator is operated by the expansion of mercury, so as to maintain a constant

* Cambridge Scientific Instrument Company, Special Catalogue, 1904.

temperature. A further advantage of the apparatus is that it can be used with gas or with a paraffin lamp as desired. In the illustration (fig. 30) a paraffin lamp is seen in position. A damper, which rises with the increasing temperature, controls the heating effect of the lamp. The device by means of which the damper is actuated depends on the relative expansion of two metals, aluminium and nickel steel; their disposition being such that the hotter the bath becomes the higher the damper is raised, so that the heat supplied to the bath becomes correspondingly less. Very close regulation of temperature is claimed for this apparatus, a constancy within 1° C. being readily maintained without the attention of the operator being required. The temperature to be maintained can be readily adjusted to a higher or lower point on the scale by a simple setting of the regulator. The bath is provided with an equipment of wax-pans, bottles, and so forth.

(4) Staining and Injecting.

New Method of Making Romanowski's Chromatin Stain.*—Giemsa uses the following receipt: Azur ii. eosin, 3·0 grm.; and Azur ii., 0·8 grm., are placed in a desiccator over sulphuric acid and well dried, thoroughly pulverised, sifted through a fine-meshed silk sieve, and dissolved by shaking up with glycerin, 250 grm. (Merck chem. rein), at 60° C. Methyl-alcohol, 250 grm. (Kahlbaum 1), previously warmed to 60° C., is then added to the mixture and well shaken, allowed to stand for 24 hours at room temperature and then filtered, and the solution is ready for use. He gives the following directions for using the stain: (*a*) the film dried in air is fixed in ethyl-alcohol, or for 2–3 minutes in methyl-alcohol, and dried with blotting-paper; (*b*) dilute the staining solution by shaking up 1 drop in about 1 c.cm. of distilled water (warming the water to 30°–40° C., assists the stain); (*c*) cover the film preparation with the freshly diluted solution, and stain for 10–15 minutes; (*d*) wash in running water; (*e*) dry with blotting-paper and mount in Canada balsam.

Staining and Preserving Algæ.—J. Q. T. gives the following particulars of a method of staining and preserving algæ, which he has found very satisfactory. The reagents required are made up as follows: Fixing solution: chromic acid, 1 oz.; glacial acetic acid, 4 oz.; formaldehyde as formalin (Schering's), 4 oz. Preserving fluids: best glycerin, 8 oz.; glycerin jelly, 1 oz. Chromo-acetic acid: chromic acid, 1 grm.; acetic acid, 1 c.cm.; water, 100 c.cm. Formalin (4 p.c.): Schering's formalin, 10 c.cm.; water, 90 c.cm. (for a 2 p.c. solution take half the quantity of formalin). Stains: hæmalum (Grübler); hæmatoxylin solution: hæmatoxylin cryst. puriss., 1 grm.; water, 200 c.cm. Iron alum solution: iron alum, 3 grm.; water, 100 c.cm. (The iron alum should be in pale violet crystals, not yellow or green, and should be kept in an air-tight tube.) Eosin solution (water soluble): eosin, 1 grm.; water, 200 c.cm.

* Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) pp. 308–11.
† Knowledge, i. (1904) pp. 305–6.

The material, which may be "fruiting" or sterile, is gathered in jars and brought home in water, or can be placed directly in the fixing solution at the time of gathering, this last being generally preferable. If fixed in the chromo-acetic mixture it will require about 12 hours for thorough fixation, and 24 hours in the formalin. After chromic acid, the material must be washed in running water or frequent changes for at least one hour, or, better, for three hours. The following simple little piece of apparatus is very useful for washing. It consists of a test-tube fitted with a cork, through which two pieces of glass tube pass. One of these is connected to a water-tap by a piece of rubber tubing, which, in turn, is connected to a piece of glass tubing passing through a cork jammed in the mouth of the tap. A piece of thin muslin is tied over the end of the other tube inside the jar to prevent the escape of specimens. With formalin no washing is necessary.

The material being fixed, the next question is the stain. If nuclei are the only details required, hæmalum will be the best to use. It should either be used strong for 5 minutes, or diluted (1 c.cm. to 50 c.cm. of water) for 24 hours. The staining must be carefully watched in both cases. Overstaining may be remedied by water acidulated (0·1 p.c.) with hydrochloric acid, but the method is somewhat risky. The other methods of staining are as follow: stain with iron alum solution for 3 hours, wash in running water for 1 hour. Stain in hæmatoxylin solution for 6–12 hours. Now comes the delicate part, for the tissues are much overstained, and must be washed in the iron solution till the details are brought out, examining with the Microscope the whole time. Immediately the details are out (generally in about a quarter of an hour) the decolorisation is stopped by placing the object in tap or rain water. Now place some water in a watch-glass and add 5 p.c. of glycerin. Transfer the algæ to the dilute glycerin and cover it with an inverted watch-glass, to prevent dust without checking evaporation. Leave until the glycerin is thick enough for mounting, mount in a shallow tin cell in just enough glycerin to fill the cell (this requires some practice), seal with gold size, and when dry ring with Brunswick black. In some cases a contrast stain may be desired. This can be obtained by placing the tissue in the eosin solution for 30 seconds or less, previous to the transference to the 5 p.c. glycerin.

(5) Mounting, including Slides, Preservative Fluids, &c.

Two Methods for Comparing Normal with Abnormal Tissues under the Microscope.* — S. G. Shattock and C. F. Selous exhibited sections illustrating the above, which they named the method of superposition and that of the composite block. The methods were more particularly adapted for class purposes, and were more especially applicable in the study of bone marrow, the central nervous system, and the blood. The plan of superposition consisted in mounting a normal section directly underneath the diseased, that is, without the intervention of a second cover-glass, so that by merely altering the focus the two could be studied in rapid succession. The sections should be

* Rep. Path. Soc., Nov. 1, 1904. See Brit. Med. Journ., 1904, ii. p. 1249.

cut from paraffin blocks, and should not be more than 2 μ in thickness. Although mounted in direct apposition there was quite a distinct microscopic interval between them, owing to the intervention of a thin layer of the mounting medium; and they were readily studied with $\frac{1}{12}$. One section was fixed to the slide, and the other to the cover-glass; or in the case of blood two cover-glasses were mounted in apposition, and then mounted to the slide. By a composite block was meant a block compounded of two; a broad face of tissue was first exposed in each of the two blocks, and the latter were then cemented together in paraffin; the sections were afterwards cut at right angles to the plane of apposition, so that by placing the section with the line of junction across the field of the microscope, a view was obtained of both the normal and abnormal tissues at the same time.

Hanging-Drop Preparations.*—J. R. Collins describes the following simple contrivance for making a hanging-drop preparation. A small rubber elastic band or washer of appropriate diameter and thickness is smeared with vaseline upon one side. This side is then applied to the slide. The upper surface of the band is now smeared with vaseline, and the cover-glass with hanging-drop is applied to it. An air-tight cell is thus readily made. This avoids the necessity for keeping special hollow-ground slides, and is more convenient than the clumsy and troublesome method of making a similar cell out of damped blotting-paper.

By the use of rubber bands of different sizes the cells can be made of any width and depth desired. Rings with a lumen of from 1–2 cm. in diameter and of 2 mm. in thickness are very convenient.

All-Metal Cover-Glass Holder.†—E. Horder has devised a cover-glass holder (fig. 31) which has the following advantages: (1) it will

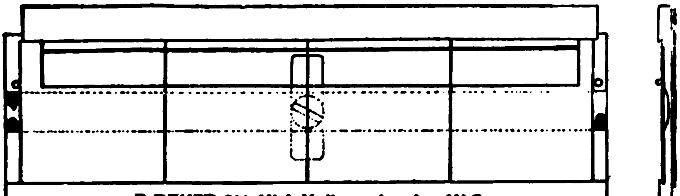

FIG. 31.

receive cover-glasses of any size in general use; (2) being made entirely of metal, it can be easily washed or sterilised; (3) specimens requiring heat can be placed in an oven with the films in position without fear of ruining the holder. Directions for use: with the holder between finger and thumb of left hand, pull sliding bar with the right until the opening is a little wider than necessary. Place cover-glasses on base-plate, bring sliding bar into apposition with covers, and the holder is prepared for taking a spread. A small projecting pin at end of plate secures covers

* Brit. Med. Journ., 1904, ii. p. 1635. † Tom. cit., pp. 759–60 (1 fig.).

from sliding off. The groove along centre of base-plate will enable the operator to remove cover-glasses easily by means of forceps.

TREADLE—**Mounting Volvox.** *English Mechanic*, lxxx. (1904), p. 300.

VILLAGIO—**Mounting Algæ.** *Tom. cit.*, p. 345.

(6) Miscellaneous.

Böhm and Oppel's Microscopical Technique.*—This well-known little volume on microscopical technique contains curt and compressed information for the histological investigation of animal tissues and organs, and its value is increased by a contribution from the late G. Born on reconstruction methods. Though the present issue has been revised and added to by A. Böhm, no reference is made to the Jenner or Romanowsky methods of staining, both procedures being in everyday use and of the greatest value.

DARWIN, H.—**Electric Thermostat.**
[An instrument designed and constructed for the special object of maintaining the prism and other parts of the spectrograph of a 24-inch refractor at a constant temperature, but the principle of the apparatus might be adapted for other kinds of thermostats.]
Phil. Mag., vii. (1904) pp. 408–14 (1 pl.).

HESKETH WALKER—**Notes on marine aquaria.**
English Mechanic, lxxx. (1904) p. 324.

HUGGINS, C. H.—**Acetylene as a gas for bacteriological laboratories.**
Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) pp. 317–20.

ROSENAU, M. J.—**Method for inoculating animals with precise amounts.**
Hyg.-Lab., U.S. Mar.-Hosp. Service Bull. 19, Washington, 1904, p. 7 (2 figs.).

Metallography, etc.

Hardness of Metals.†—At a meeting of the Birmingham Metallurgical Society of the Municipal Technical School, Professor Turner gave a lecture on the hardness of metals. The lecturer said that hardness was a property of great importance in connection with the practical application of metals to the arts. In some cases, as with a knife-blade, the continuance of a good cutting edge was of the utmost importance; while in other instances, as with castings which have to be machined, softness was a special requisite. The relatively small differences in hardness which resulted in success or failure were such as could only be measured by accurate methods. Hardness might be defined as the resistance offered by a body to penetration by another body. As the penetrating substance might act in various ways, such as by making a sharp cut, an indentation of considerable size, or an abrading effect, the measure of hardness would depend upon the system of test adopted, and the rapidity with which the test was made. No one test would suit all practical requirements. It was pointed out that in alloys the hardness differed from the mean of the constituents, and was usually higher than that with pure metals. The lecturer then gave a brief historical account of the developments of the methods for determining relative hardness. Among the methods specially recommended by the lecturer

* R. Oldenbourg, Munich and Berlin, 5th ed. (1904) 271 pp.
† English Mechanic, lxxx. (1904) p. 404.

were the Sclerometer, using a weighted diamond point, general application, the method of Brunel for mild steel and similar materials, and the drilling test of Keep for cast iron. In conclusion, the lecturer emphasised the necessity for greater attention to the quantitative determination of the relative hardness of metallurgical products on account of the enormous differences in the usefulness and length and life of tools, nails, tires, and numberless other articles, due to what might at first sight appear to be unimportant differences of hardness.

Possible non-brittleness of Steel under certain conditions.*—C. Frémont points out that the general opinion as to all steels and irons, whatever their quality, becoming brittle in consequence of a permanent deformation effected statically or by shock between 200° and 450° C., is only a hypothesis. He quotes experiments to show that Denain steel, used for the boilers of locomotives on the West of France Railway, is an exception. Hence he concludes that the usual brittleness is not an inherent property of the metals, but is a defect capable of being overcome by suitable conditions of manufacture.

Certain Properties of Alloys of Silver and Cadmium.†—The variability in composition of silver-copper alloys has always been a difficulty in questions of trial plates for coinage and silversmiths' work. Samples taken from the corners and centre of the same ingot will, even under the most favourable circumstances, show a difference in composition of 1·2 per 1000, or sometimes more. T. K. Rose has found that trustworthy and convenient trial-plates can be made of silver and cadmium. His investigations included a study of the microstructure from which he concludes: (1) That evidence is afforded of the existence of the compounds $AgCd_3$, Ag_2Cd_3, $AgCd$, Ag_3Cd_2, Ag_2Cd, and Ag_4Cd; (2) That the alloys containing from 0–25 p.c. of silver consist, when solid, of crystals of $AgCd_3$ set in a matrix of cadmium. Those containing between 25 and 40 p.c. of silver consist of the compound Ag_2Cd_3 set in a matrix consisting mainly of $AgCd_3$. The alloy containing about 50 p.c. of silver consists of crystals of a silver-rich body set in a matrix consisting chiefly of $AgCd_3$. The matrix or eutectic solidifies at 420°, or nearly 300° C. below the freezing point of the crystals. The alloys containing from 50–60 p.c. of silver consists, at temperatures above 420° C., of mixtures of two different solid solutions, one of which is chiefly composed of the compound $AgCd$, and the other of Ag_3Cd_2. Traces of the eutectic freezing at 420° C. are still visible. When more than 80 p.c. of silver is present, the alloys consist of a mixture of two bodies at temperatures between the liquidus and solidus curves, but these unite to form a single solid solution at points on the solidus curve; (3) That the alloys containing over 80 p.c. of silver do not undergo segregation under ordinary conditions, and are practically homogeneous and uniform in composition. They are well suited as a material for the manufacture of trial-plates.

* Comptes Rendus, cxxxix. (1900) pp. 1032–3.
† Proc. Roy. Soc., lxxiv. (1904) pp. 218–30 (8 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 21st OF DECEMBER, 1904, AT 20 HANOVER SQUARE, W. G. C. KAROP, ESQ., M.R.C.S., IN THE CHAIR.

The Minutes of the Meeting of the 16th of November, 1904, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society since the last Meeting, exclusive of exchanges and reprints, was read, and the thanks of the Society were voted to the donors:

George C. Whipple, Report of the Commission on Additional Water Supply for the City of New York. Appendix VI. Chemistry and Biology. (No date)	*The Author.*
Records of the Egyptian Government School of Medicine. Vol. II. Edited by the Director. (4to, Cairo, 1904)	*The Director*

The Chairman said that, in consideration of the atmospheric conditions existing that evening, and the consequent difficulty which the Fellows might experience in reaching their homes, the Council had decided that any discussion which might arise on the paper to be read, should not be protracted beyond half-past nine.

Mr. A. E. Conrady read a short paper on an experiment shown in the room by means of Abbe's Demonstration Microscope, which proved by a change in the apparent position of the lines of a grating brought about by changing from direct to dark-ground illumination, that two successive spectra from that grating were opposed to each other in phase, as he had predicted theoretically in his paper read at the November meeting of the Society. He thought this conclusively showed that *correctly worked out* deductions from the undulatory theory could always be depended upon to be borne out by experiment.

Mr. Rheinberg said he was profoundly impressed by the way in which the points referred to had been brought out in this paper. He had been present when the experiment proposed by Mr. Conrady was made, and it was quite startling to see how exactly his prediction had been verified, and how by the mere shifting of a diaphragm they could make the image of one set of alternate black and white lines shift its position, whilst another nearly similar set—in view at the same time—

retained its position unchanged. He did not think it would be possible to account for this in any other way than by differences of phase in the spectra of the two sets of lines. He thought Mr. Conrady was to be congratulated on having so successfully worked out an important point in the theory of microscopic vision.

The thanks of the Society were then, upon the motion of the Chairman, unanimously voted to Mr. Conrady for his paper, and for his experimental proof of the correctness of his theory.

Mr. J. W. Gordon then gave a summary of his paper "On the Theory of Highly Magnified Images," and illustrated his remarks by diagrams shown upon the screen.

The Chairman expressed the thanks of the Meeting to Mr. Gordon for his communication, and in asking for remarks on the subject, reminded intending speakers of the time limit previously mentioned.

Mr. Rheinberg, after premising that he had had an opportunity of studying an advance proof of Mr. Gordon's paper, and having obtained the Chairman's permission to read his remarks thereon, said: It appears to me that advance in the domain of microscopic optics depends upon simplification of existing theories, and upon a ready willingness to recognise that a subject such as this may be regarded from many standpoints which, when carefully examined, mutually aid each other. Reviews of the subject, such as Dr. R. T. Glazebrook's Presidential Address before the Physical Society of London, this year, in which various theories are carefully compared in simple language, cannot fail to assist in progress and be helpful to the student. Similarly refreshing and helpful are papers like the masterly one brought before the Society at the last meeting by Mr. A. E. Conrady, in which, working on the lines of a well-established theory, certain matters are cleared up, explained, and simplified in a plain, straightforward manner, with interesting new points, readily demonstrable experimentally, following as a consequence. But the paper read this evening cannot be classed with these. To him it appeared throughout as a complication, and even inadvertent perversion, alike of the many well-known facts which it discusses and sets itself to explain, and of the new ideas which it propounds.

He would do no more than refer to a few examples.

The well-known and famous Abbe theory is dismissed as incorrect and useless in a proposition which is quite irrelevant. He said *the* Abbe theory advisedly, for it stands beyond doubt that that theory includes the deduction of effects in the view plane from those in the region of the upper focal plane of the objective. Far from being disavowed, the fact is so apparent from any of Professor Abbe's papers on the subject, that it would seem almost superfluous to mention that he knew it besides from a personal conversation with that distinguished man of science in 1902. Mr. Gordon's disproof has so little to do with the question at issue, as in itself to show that he has entirely failed to understand the elements of that theory.

The main point of Mr. Gordon's paper appears to be a speculation

about antipoints not being in the same phase over their whole area, and some deductions arising therefrom. Now Mr. Gordon's "antipoints" are but another name for the false discs, or spurious discs, or diffraction discs, with their attendant rings, of other writers, and that phase changes occur in connection with these has been known as long ago as 1835, as may be seen from Schwerd's book, "Die Beugungserscheinungen," published in that year. Mr. Gordon, it is true, refers to antipoints in connection with illuminated points, as well as self-luminous points, but as the factors which determine the change of phase are the same in both instances, this will not affect the question.

The analysis of the image into antipoints which overlap, and in which the overlapping parts bear a phase relationship to one another, which has to be taken into account, seems a perfectly legitimate proceeding (provided we deal with an object of no thickness, or with the plane surface of an object, and know the phase and amplitude of every point on that surface). But here comes the interesting part. The recognition of this matter is an admission that the image of one point of an object may be modified by the light which arrives at some neighbouring, or more or less distant point of the object, because these points, to begin with, bear some phase relationship to each other—one of the facts assumed *ab initio* by the Abbe theory, which has been subject to so much debate.

Having come to recognise this, we find some unusual deductions drawn therefrom. Because Lord Rayleigh has defined the conditions under which an isolated luminous point, an isolated luminous line, or an isolated dark bar will be visible, showing that in the latter case there would be some difference, according to whether the surface on each side of the bar were in a state of phase relation or not, therefore Mr. Gordon jumps at the conclusion that he can now so manipulate matters as to get a greater resolving power than heretofore. The factors on which the resolving power depend, viz. the minimum size of the diffraction disc or antipoint (due to the aperture of the objective) are forgotten entirely; the fact that Lord Rayleigh dealt with isolated, not periodic structure, in the investigations to which he refers, is ignored, and it is likewise overlooked that Lord Rayleigh carefully pointed out that the apparent width of lines or dots seen under such conditions is illusory, and bears no relation to the real width; in short, Mr. Gordon falls into the mistake of confounding the problem of resolving power with results analogous to those by which Dr. H. Siedentopf rendered ultra-microscopic particles visible before this Society last year.

And from this we pass to a consideration of *conical wave-fronts*. Now a wave-front, so all text-books tell us, must satisfy three conditions. It is a surface the points of which are in the same phase, the wave-motion having arrived there from the same source in the same time—or, in other words, the optical path-length between the source and every point of the wave-front must be the same. Perhaps Mr. Gordon will kindly show how the conical wave-front and the doubly conical wave-front which is suggested later on comply with these conditions. The fact, of course, is that since in the Microscope we have only to deal with spherical refracting surfaces, a conical wave-front cannot

possibly be produced, and becomes an absurdity. But supposing for a moment we really had a conical wave-front, let us see how Mr. Gordon employs it in the solution of problems. For this purpose the well-known principle of Huyghens is invoked, the principle which shows how you may arrive at the state of the light on one surface, if you have a wave-front travelling towards it, by regarding every point on the wave-front as a new source, or centre, from which rays start forward in all directions, and then examining what the resultant phase is, on points of the new surface, of rays which have arrived there from every point of the known wave-front. But how does Mr. Gordon apply these rules? He does not apply them at all, but simply transfers the result which they give, in the case of a spherical wave-front, to that of the supposed conical wave-front. That is, he alters the conditions entirely on which the result depends, but nevertheless applies the result.

While Mr. Gordon realises certain portions of the work of well-known physicists—sometimes portions which have got neglected or overlooked, and which it is a real benefit to have brought into prominence—he so entirely fails to grasp other and contingent matters explained by the same authors, interspersing it with deductions that have never been made, and improving upon it by laws of his own, which disregard elementary optical principles, that the final result is an almost unexampled confusion.

Mr. Beck said he must protest against the kind of paper which had just been read by Mr. Rheinberg, which might have been suitable in a debating society in order to amuse the members, but in their own Society their object was to arrive at scientific truth, and not to be entertained by a dissertation upon what Mr. Gordon did, or did not do, or ought to have done. It appeared to him that the question before them was drifting into partisan lines, and if it were allowed to do that they would never get any further towards truth in this direction. The paper of Mr. Gordon was a very interesting résumé of the work of Professor Airy and others, and he thought the question of phase relation was an extremely interesting one, as under all circumstances where they had two spurious discs they probably had a dark line of some size between the two portions. As far as he was aware, this observation was quite new. It was also extremely interesting to be told of two wave-fronts being propogated in opposite directions.

Mr. Beck then referred to an optical apparatus exhibited in the room to show the effect produced by the interposition of a grating. The object was one of Grayson's rulings, the lines of which were almost invisible until the grating was introduced, the effect of this always being to make them more black and white—although he would not like to say that he could see a finer band of lines with it than he could without it.

Mr. Conrady said he quite agreed with Mr. Beck that personalities should be kept out of scientific discussions, but he thought that such considerations must not prevent them from inquiring into the validity and accuracy of the statements contained in papers under discussion. Having also had an opportunity of reading Mr. Gordon's paper in advance, he had prepared the following remarks upon it.

When a new theory is being proposed, one naturally looks first and

foremost for the proofs offered in support of the innovation, and one expects these proofs to be the more ample and convincing the better established the views happen to be which are to be swept aside.

Now Sir George Airy's paper on the diffraction of object-glasses, which helped to win for him the Copley Medal of the Royal Society in 1831, takes high rank among the classical papers on optical subjects, and has been universally accepted as an exhaustive and *final* treatise on the spurious disc. Yet it is chiefly by trying to prove that Sir George Airy had failed to fully grasp the problem he attacked, that Mr. Gordon seeks to establish his own ideas about the spurious disc.

Mr. Gordon finds fault with the principal result of Airy's paper, namely, the interesting phase relation between the central disc and the rings, which is brought to light in Airy's table of simultaneous amplitudes, and which, owing to the method by which the table was computed, cannot be wrong unless the numerical values of the amplitudes themselves were utterly wrong. Now it so happens that this remarkable fact, viz. that the whole of the central disc and the even-numbered rings are at any instant in a uniform phase exactly opposed to that of the odd-numbered rings, is the one easily demonstrated peculiarity of the spurious disc, for it is the necessary consequence of the symmetry of a circular aperture with regard to a diameter, and comes about in much the same manner as the exactly similar phase relation which I proved to exist in the case of diffraction spectra, in a paper which I contributed last month.

The only argument in support of Mr. Gordon's objection to Airy's result consists in a wholly inadmissible suggestion that amplitudes had no positive or negative signs. For those who have not sufficient faith in the great Astronomer-Royal to accept his conclusions, it may be pointed out that the painstaking pioneer in the study of diffraction phenomena, Schwerd, arrived at precisely the same results quite independently of Airy. Mr. Gordon tries to put his contention into mathematical form by two equations purporting to yield the result of the combination of two amplitudes. Both these formulæ are irreconciliable with the undulatory theory, and can easily be shown to be erroneous. Taking the first—

$$A_{(1+2)} = A_1 + \cos \frac{\phi}{\lambda} 2\pi \,.\, A_2.$$

This is impossible, for purely mathematical reasons, because it is not symmetrical with regard to A_1 and A_2. For it is purely arbitrary which amplitude we are to designate as A_1 and which as A_2; the exchange of A_1 and A_2 should, therefore, yield the same result. But Mr. Gordon's formula yields two different results by this perfectly legitimate exchange; for instance, if the phase difference should happen to be 90°, the second term of the formula becomes zero, and we obtain the surprising result that one of the amplitudes *vanishes*, leaving the other in sole and undisturbed existence; and the absurdity becomes more manifest when we exchange A_1 and A_2, as we then find that the combined effect must be equal to *either* amplitude, although they are assumed to be different.

The second formula may be proved to be wrong by similar reasoning: for instance, if the two phase angles are both equal to ± 90°, the result-

ing amplitude becomes zero, which is manifestly absurd in the case of two unequal amplitudes.

The *correct* substitute for these two formulæ is, adopting Mr. Gordon's symbols,

$$A_{(1+2)} = \sqrt{A_1^2 + A_2^2 + 2\,A_1\,A_2 \cos\frac{2\,\pi}{\lambda}\,(\phi_1 - \phi_2)}$$

an equation which possesses the necessary symmetry with regard to the quantities applying to the two combining waves, which satisfies common sense inasmuch as it shows that both waves invariably contribute to the result, and which fully explains every possible case in accordance with experience.

The phase angle $\frac{2\,\pi}{\lambda}\,\phi$ of the resulting wave, which Mr. Gordon does not even attempt to deduce, is obtained quite definitely from the *two* equations—

$$A_{(1+2)} \cos\frac{2\,\pi}{\lambda}\,\phi = A_1 \cos\frac{2\,\pi}{\lambda}\,\phi_1 + A_2 \cos\frac{2\,\pi}{\lambda}\,\phi_2.$$

$$A_{(1+2)} \sin\frac{2\,\pi}{\lambda}\,\phi = A_1 \sin\frac{2\,\pi}{\lambda}\,\phi_1 + A_2 \sin\frac{2\,\pi}{\lambda}\,\phi_2.$$

Seeing that these three equations contain the complete and *only possible* solution of this simplest problem in the study of interferences, and that they are, therefore, to be found in the earliest chapters of any book on the mathematical treatment of such problems, it is highly significant that they should be unknown to Mr. Gordon, and that he should have found it necessary to invent those absurd and incomplete substitutes. It seems hardly worth while to examine any further attempts at mathematical proofs from one so ill-prepared for such tasks, but I will follow him a little further.

Having, in the face of Airy's results, derived conclusions to his liking from the assumption of a "polyphasal antipoint," he attempts to prove the existence of such "antipoints" in an appended note. And here he entirely brushes aside the well-established principles of the undulatory theory, and calmly suggests that Airy should have integrated not over the aperture which passes the light, but over a small portion of the cone which encloses the wave-train converging towards the focus. Surely a more startling proposition has never been made. We have energy in the form of light being transmitted in converging waves towards a focus, and we are to disregard nearly the whole of that energy and of those waves, and are to confine our attention to a narrow strip down the side of a cone—which is indeed "polyphasal" with a vengeance, but which conveys only an infinitesimal fraction of the total energy.

It need hardly be stated that even a correctly worked out result based on such assumptions would be entirely worthless, but the mathematical expressions which follow have not even that merit, for, from what has just been pointed out, it is clear that the correct result of the proposed integration must necessarily be an infinitesimally small amplitude, whilst

Mr. Gordon, by a succession of mysterious operations, succeeds in arriving at the finite result which he covets.

The proofs offered in support of the new ideas being thus found to be absolutely worthless and absurd, all the conclusions drawn from assumptions proved to be false necessarily fall to the ground. It may only be added that the black and white dot phenomenon which Mr. Gordon tries to claim as an experimental proof of his strange proposition does not at all call for "conical wave-fronts" and "polyphasal anti-points" in explanation. For on the basis of the usual theory it follows at once, that when we go either within or beyond the true focus, the wavelets from different zones of the object-glass will arrive with a difference of phase in the new image plane, and will therefore interfere; and there must be a point on either side of the true focus where this interference is complete, and results in a dark centre of the spurious disc.

Unfortunately, there are many statements in this paper which cannot be allowed to pass unchallenged.

First of all, we find a repetition of the absolutely unfounded assertion that Professor Abbe had disavowed the theory of microscopical images which bears his name,* and the reiteration is the more disingenuous because Professor Abbe is unfortunately now unable to defend himself; and it is rendered more offensive than before by being advanced in the form of a protest against an alleged misuse of Professor Abbe's name in connection with his world-famous theory.

The few statements by which Mr. Gordon tries to discredit the Abbe theory only prove once more how completely he has misunderstood that theory, which apparently he has not studied in the only full and authentic account, viz. that in Dippel's handbook. Incidentally, Mr. Gordon refers to his "proof of the sine condition," which, as a matter of fact, is no proof at all; a postulate is put forward which, far from being "almost axiomatic," is indeed manifestly absurd; a wholly arbitrary diagram—which has no ostensible relation to any lens system—is then drawn which, *by construction*, implies a sine relation, and having thus drawn this diagram, Mr. Gordon proves that it does indeed follow a sine law. Anything whatever may be proved by this method.

As a matter of fact, neither this alleged proof, nor the claim that the sine condition secured an *extended* and *flat* field, can be substantiated; all the valid proofs imply, directly or indirectly, the principle of the minimum optical path (this was, I believe, first pointed out by Lord Rayleigh), and are in consequence limited to an element of surface in the optical axis. That objectives which fulfil the sine condition generally have a sufficiently large field within which the definition is satisfactory,

* The following sentence from the passage in Carpenter-Dallinger (pp. 64–65 of the eighth edition), on which Mr. Gordon relies, should alone suffice to show that Abbe, far from disavowing his theory, claimed it as universally applicable:—"Theoretical considerations have led me to the conclusion that there must always be the *same* conditions of delineation *as long as the objects are depicted by means of transmitted or reflected light*, whether the objects are of coarse or of very fine structure. Further experiments . . . have enabled me to observe the diffraction-effect and its influence on the image, viewing gratings of not more than forty lines per inch." (The italics are taken from the original.)

is entirely due to the small influence near the optical axis of the disturbing factors which eventually, beyond a certain limited field, assume such proportions as to destroy all semblance of definition, no matter how rigorously the sine condition may be fulfilled, and the sine condition has nothing whatever to do with a *flat* field, which is, as a matter of fact, impossible of attainment in Microscope objectives of considerable N.A., as the essential Petzval condition cannot possibly be fulfilled in these.

Helmholtz next comes in for his share of "criticism."

This most careful and philosophical physicist is accused of precipitation, and the suggestion—of course utterly unfounded—is made against him that he has left half his work undone. And the now well-known postscript to his paper,* which is really devoted to a very flattering reference to Professor Abbe's theories, is cited in proof, although it *begins* with the statement that Helmholtz's paper had been *completely worked out* and made ready for the printer when he became acquainted with Abbe's researches.

On pages 16 and 17 of Mr. Gordon's paper an attempt is made to prove that Lord Rayleigh supported at least some of the novel notions. More particularly, Lord Rayleigh's statement as to the resolution of two very close lines under a certain kind of oblique illumination is cited. Here Mr. Gordon overlooks that the illumination called for is that there must be a difference of phase of $\frac{1}{2}\lambda$ between the light reaching the two lines from the distant source. Evidently this condition can only be realised when the two lines are at least $\frac{1}{2}\lambda$ apart, in which case it calls for grazing incidence; this case of abnormal resolution, imperfect though it is, and restricted, moreover, to an isolated pair of lines—rather a rare object—therefore breaks down at the very point where it might occasionally be of value, i.e. at the universally accepted limit of resolution; and Lord Rayleigh himself is evidently aware of this, for he has often since that demonstration expressed his faith in the approximate correctness of the accepted limit of resolution. The visibility of single bright or black lines or dots is a matter apart altogether, as Lord Rayleigh invariably points out; it is a question of contrast rather than of resolution, and such small black or white dots or lines cease to be visible wherever a number of them are clustered together at distances within the accepted limit of resolution.

It is difficult to see how science is to profit by these absolutely unfounded attacks on its foremost exponents, and by these strange misinterpretations of their writings. It seems to me that Mr. Gordon's views will result in misleading a large majority of microscopists who are not sufficiently acquainted with optics and mathematics to be able to detect the weak points by their own unaided scrutiny. And it is to such microscopists that I suggest that they should put to themselves the following question:—If the accepted limits of resolution be false, and if Mr. Gordon should have really discovered means of evading them, why does he not convince us by the simple and straightforward process of

* A translation of this postscript will be found in the report of the discussion on Mr. Gordon's second paper in Part 2 of the Journal of the R.M.S. for 1903.

showing us, say, a normal specimen of *Pleurosigma angulatum* plainly resolved with an object-glass of N.A. less than ·5, or a normal specimen of *Amphipleura pellucida* similarly resolved with a dry objective under ·9 N.A., or indeed any test object resolved under conditions under which it could not be resolved according to the accepted theories?

Mr. Gordon having been invited to reply, said: Mr. Conrady has been good enough to furnish me with a copy of his criticism of my paper. To a considerable extent these remarks, like those read by Mr. Rheinberg, consist of oracular utterances on the subject of my incompetence, and with these I do not propose to occupy your time. They express, no doubt correctly, the opinions of these gentlemen, and, as they do not purport to express more, they do not properly admit of an answer.

Mr. Conrady, however, does not confine himself to inarticulate criticism. He puts forward specific objections to certain of my points, and, with a singular lack of caution, selects for the object of his principal attack equation No. 2, which appears on page 7 of my paper, and expresses a resultant amplitude as follows—

$$A_{(1+2)} = \left(A_1 \cos \frac{\phi_1}{\lambda} 2\pi + A_2 \cos \frac{\phi_2}{\lambda} 2\pi\right)$$

Mr. Conrady thinks that I ought to have compounded these two amplitudes according to a different rule, and one which, oddly enough, does not yield a true resultant amplitude at all. When undulation trains combine which have originated in independent sources of light and have no fixed phase relation *inter se*, it is impossible to calculate their actual resultant, for the simple reason that the actual components are in such a case unknown. The best we can do is to calculate an average resultant, and for this purpose the equation has been devised which Mr. Conrady has selected and recommended as an alternative to that which I have above set out. The case, however, with which I was dealing is a case of undulations which have a fixed and permanent phase relation between themselves, and what I wanted to get at is, not an average, but an actual resultant. In the case contemplated the actual resultant can be computed, and by the ordinary equations applicable to the composition of co-planar forces.

Now Mr. Conrady, in fact, does himself less than justice by this erratic criticism. The formula which he speaks of as having been invented by me, is very far indeed from having been newly devised, and on the contrary has been employed before, and invariably, by other writers attacking the same problem. If we assume, instead of two impulses, an indefinite number, say n, the above equation is written in the following form:

$$A_{(1+2+\ldots+n)} = \Sigma\left(A_1 \cos \frac{\phi_1}{\lambda} 2\pi + A_2 \cos \frac{\phi_2}{\lambda} 2\pi + \ldots + A_n \cos \frac{\phi_n}{\lambda} 2\pi\right)$$

If now we assume that all the several impulses A_1, A_2, etc., are equal to one another, then we may for these individual symbols substitute a common factor which may be written c.

Again, if we find it convenient to take our impulses in pairs and for

the sum of n single components to substitute the sum of one half of n pairs of components, in that case this common factor will become $2c$.

Yet once again, if for the phase angle $\frac{\phi_n}{\lambda} 2\pi$, we write the arbitrary symbol β_n, the above equation will become

$$A_{(1+2+\ldots n)} = \Sigma (2c \cos \beta_n)$$

Now, turning to page 619 of the last volume of the Society's Journal, I find a table incorporated in Mr. Conrady's paper there printed on "Theories of Microscopic Vision," and in column 3 of that table I find the successive values of this expression $\Sigma (2c \cos \beta_n)$, tabulated for a series of values of the angle β_n, and put forward as being the compound amplitude $A_{(1+2+\ldots+n)}$.

Mr. Conrady in the paper to which I am referring makes all the assumptions above enumerated, together with a further assumption which involves, as an item in his equation, an additional factor, sin α. This sin α causes great embarrassment to Mr. Conrady, and eventually he disburdens himself of it by arbitrarily treating sin α as being $= 1$. Whether in the circumstances in which he found himself that was a legitimate way of eliminating a troublesome factor is a question which it is not here necessary to discuss, but column 3 of the table referred to shows conclusively that the equation which Mr. Conrady now attacks with so much warmth is not a thing of my devising.

With reference to one other point upon which Mr. Conrady has dealt with a matter of fact, I desire to point out that he has fallen into an error. It is not correct to say that Lord Rayleigh's results apply only to one, and that an exceptional, case. Lord Rayleigh dealt with three cases, one of them being a case in which there was no determinate phase relation between the overlapping antipoints. Even in that case the black bar limit of resolution is $\frac{1}{16}$ of a wave-length, not a half wave-length, as previously supposed. Where the phase relation is favourable, this limit comes down to $\frac{1}{32}$ of a wave-length, and where specially favourable the limit is evanescent. This is quite accurately stated in my paper.

I do not propose to follow Mr. Conrady in detail through his criticism, since a controversy on those lines would not only be tedious but would fall much below the level of scientific discussion. I will notice only one other point, and that because it is barbed by a charge of disingenuousness which Mr. Conrady thinks fit to bring forward. This relates to Professor Abbe's disclaimer of the Abbe theory. In a passage now well known, and which appears in Carpenter's book on the Microscope, Professor Abbe wrote: "I no longer maintain in principle the distinction between the absorption image [or direct dioptrical image] and the diffraction image, nor do I hold that the microscopical image of an object consists of two superimposed images of different origin or different mode of production.

"This distinction, which in fact I made in my first paper of 1873, arose from the limited experimental character of my first researches, and the want of a more exhaustive theoretical consideration at that period," etc.

Now this is as precise and full a disclaimer as can be framed, but Mr. Conrady says that it does not mean what it appears to say. He quotes the context to show that Professor Abbe really intended something else to be understood. Whether this be so or not I decline to conjecture. I never have undertaken to explain, and do not propose undertaking to explain, what Professor Abbe may have meant. At least the language which he there employs makes it proper to await some further utterance on his part before attributing to him any precise views upon the subject covered by his original statement. For that reason I have always been careful when criticising expositions of the Abbe theory put forward by other writers to abstain from attributing the views thus brought into discussion to Professor Abbe himself, and it is for thus distinguishing between the master and the disciple that I am blamed. Now I can quite understand that a distinction of that sort may be distasteful to those whom it affects. I do not forget the old adage that comparisons are odious, and I can imagine that on some such ground as that, possibly on grounds that do not occur to my mind, complaint might be made of my disputing the authenticity of various Abbe theories which I have from time to time criticised. But to say that it is disingenuous must be a blunder: the point is badly taken.

The Chairman said that feeling upon this subject seemed to be getting very acute, but whatever individual opinion might be held, there was no doubt they were all much indebted to Mr. Gordon for his very interesting paper.

The Chairman reminded the Fellows present that their Annual Meeting would be held on January 18, when they would be asked to elect Officers and Council for the ensuing year; and the list of those proposed by the Council was read by the Secretary.

The Fellows were then asked to elect one of their number to act as Auditor of the Society's accounts for the year in conjunction with the Auditor appointed by the Council.

Mr. C. L. Curties was then proposed, seconded, and unanimously elected Auditor on behalf of the Fellows of the Society.

The following Instruments, Objects, etc., were exhibited :—

Mr. A. E. Conrady :—Experimental proof of phase-reversal in the second spectrum from a grating of broad slits.

Mr. Julius Rheinberg :—Photographs taken with the Abbe Demonstration Microscope, illustrating the influence on the images of gratings of phase difference amongst their spectra, in accordance with the results of Mr. A. E. Conrady.

ANNIVERSARY MEETING,

HELD ON THE 18TH OF JANUARY, 1905, AT 20 HANOVER SQUARE, W.
D. H. SCOTT, ESQ., Ph.D. F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 21st of December, 1904, were read and confirmed, and were signed by the President.

Mr. G. E. Mainland and Mr. G. H. J. Rogers were appointed by the President as Scrutineers of the ballot for election of Officers and Council for the ensuing year.

The List of Donations to the Library, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society voted to the donors.

	From
Herbert S. Jennings, Contributions to the Behaviour of Lower Organisms	*The Author.*
An Adams' Lucernal Microscope by W. and S. Jones .. .. .. An Old Portable Microscope	*Lt.-Col. Tupman.*

The President said that amongst the deaths which would be referred to that evening, there was one of quite recent occurrence which the Fellows of the Society would hear of with very painful interest—that of Professor Abbe, of Jena. There was perhaps no one whose loss would be more felt by a Society such as their own, than Professor Abbe, whose name was familiar to everyone acquainted with the Microscope; and even those who, like himself, were not able to follow the details of Professor Abbe's work, could not fail to recognise the very remarkable services which he had rendered to optical science. He had been an Honorary Fellow of their Society since 1878, and the Council had proposed that a vote of condolence should be passed by the Society and forwarded to his family. This proposition was then put to the Meeting, and unanimously carried.

The Report of the Council for the year 1904 was then read by the Secretary.

REPORT OF THE COUNCIL FOR 1904.

FELLOWS.

Ordinary.—During the year 1904, 17 new Fellows have been elected and 3 re-instated, whilst 10 have died, 14 have resigned, and 3 have been removed.

Honorary.—The following were elected Honorary Fellows at the

Meeting in June last: G. Bonney, J. Brun, Yves Delage, S. Ramón y Cajal, B. Renault, J. J. H. Teall, Silvanus P. Thompson, and M. Treub.

The Council regrets to have to announce the death of Professor Renault, which occurred within four months of his election as an Honorary Fellow.

The number of Honorary Fellows is now 40.

The list of Fellows now contains the names of 415 Ordinary, 1 Corresponding, 40 Honorary, and 82 Ex-Officio Fellows, being a total of 538.

FINANCE.

The amount received for Subscriptions during the past year is somewhat less than that in the previous account. This is principally due to the fact that many Fellows have not yet paid their Subscription.

It is, however, necessary to point out that the number of new Fellows elected during the past few years has not kept pace with the loss by deaths and resignations.

Fellows are therefore urged to do their best to enlist new members, as it is only by this means that the financial position of the Society can be maintained satisfactorily.

During the year a bequest was made to the Society by Mr. E. Dadswell, but the amount not having been yet received, will be included in next year's account.

The sum of £200 on deposit at the end of last year has been invested during the year, together with the entrance and compounding fees received in 1903.

JOURNAL.

The papers, twelve in number, which are embodied in the Transactions have been fully up to the standard of previous years. Two of them were read by the late Professor J. D. Everett, F.R.S., and were probably the last delivered by this distinguished mathematician and physicist. In addition to the foregoing, six short but valuable communications are published in the "Notes," a feature introduced by the late Editor, Mr. A. W. Bennett, which, judging from the nature of the articles and their gradual increase in number from year to year, seems to supply a want.

The Summary of Current Researches relating to Zoology, Botany, Microscopy, and Metallography is continued on the same lines as heretofore; and the Council takes this opportunity of again thanking the Editorial Staff, which has laboured long and unremittingly on behalf of the Society and its Journal.

LIBRARY.

During the past year the Library has been maintained in as efficient a manner as the available funds will permit. It has not yet been found possible to undertake a printed catalogue. The want of this desideratum is the cause of much inconvenience to Fellows who consult the collection of Books and Journals, and the usefulness of the Library is greatly restricted in consequence.

INSTRUMENTS AND APPARATUS.

The Instruments and Apparatus in the Society's Collection continue to be in good condition.

During the past twelve months the following additions have been made:—

Feb. 17.—An Old Microscope, by Bate, being a late form of Ellis's Aquatic Microscope, described by Adams in 1787. Presented by Mr. Ed. B. Stringer.

April 20.—A Tank Microscope, by Thos. Ross. Presented by the Committee of the Quekett Microscopical Club.

May 18.—A Students' Microscope, by Ladd. Presented by Mr. Wynne E. Baxter.

Oct. 19.—Additional portions of Adams's Lucernal Microscope (the major portions having been presented in Feb. 1903). Presented by Mr. Frank Orfeur.

Nov. 16.—A Cuff New Constructed Double Microscope, by Dollond. Presented by Mr. Chas. Lees Curties.

A Jones's most Improved Compound Microscope, by Banks. Presented by Mr. Chas. Lees Curties.

The numerous additions of late years to the Society's Collection of Old Microscopes have completely filled the available space in the Cabinets; and owing to the overcrowding none are suitably or worthily displayed. Moreover, the Cabinets do not contain by any means the whole of the Society's Collection, for a number of instruments still remain packed away in cases, and are therefore never on view.

From what has been said it may be gathered that a printed Catalogue and an additional Cabinet are not only desirable but necessary. The Council, however, does not, at the present juncture, feel justified in sanctioning the expense, especially as on the last occasion when a Library Catalogue was printed, though some of the Fellows warmly appreciated it, the majority appeared to be indifferent, and the sales of it were merely nominal. The Council is therefore desirous of obtaining from Fellows some expression of opinion on the subject, and of learning what support they might expect to receive if it were possible later on to entertain the proposal to print a new edition of the Catalogue.

The Council would also suggest that the need for such a Catalogue and a Museum Cabinet might afford fitting objects for private generosity on the part of those Fellows who feel keenly their necessity.

The MS. of the Catalogue has been compiled at much cost of time and labour by the Hon. Librarian, and the Instruments are most carefully kept by the Hon. Curator; it would therefore be a great encouragement to both these Officers if their special requirements were provided for by the generosity of Fellows.

The Treasurer then read the cash statement for the year 1904, which had been duly audited and certified as correct by Messrs. J. M. Allen and C. L. Curties.

He did not think that the financial statement called for any special

Dr. CASH STATEMENT FOR THE YEAR ENDING 31st DEC. 1904. Cr.

1904.		£ s. d.
To Balance from 1903		60 19 0
„ Admission Fees		38 16 0
„ Annual Subscriptions—		
1895	0 3 7	
1896	4 5 5	
1902	14 6 0	
1903	27 11 3	
1904	578 9 4	
1905	31 9 6	
1906	4 4 0	
		660 9 1
„ Interest on Investments and Deposit Account		55 11 1
„ Sale of Journal		300 5 0
„ Receipts for Advertisements		60 0 0
„ „ „ Sale of Surplus Books		3 4 0
„ „ „ Reprints and List of Fellows		9 6 7
„ „ „ Screw tools		0 5 0
„ Withdrawn from Deposit		400 0 0
„ Income Tax returned		2 10 1
		£1591 5 10

1904.		£ s. d.
By Rent, Coals, etc.		132 17 0
„ Salaries and Reporting		158 12 0
„ Books purchased		59 4 6
„ Bookbinding		12 1 6
„ Expenses of Journal—		
Printing and Postage	£398 17 5	
Illustrations	58 17 1	
Editing and Abstracting	149 11 0	
		607 5 6
„ Purchase of 287*l.* 17*s.* 8*d.* India Three per Cents.		276 10 0
„ Placed on Deposit		200 0 0
„ Refreshments at Meetings		13 10 0
„ Stationery		15 18 0
„ Fire Insurance		3 5 0
„ Postage and Petty Expenses		43 13 3
„ Repairs		0 8 0
„ Balance in hand		68 1 1
		£1591 5 10

Investments.

	£ s. d.
North British Railway	400 0 0
Nottingham Corporation Stock Three per Cents.	400 0 0
New South Wales Three and Half per Cents.	315 11 1
India Three per Cents.	825 3 7
	£1940 14 8

J. J. Vezey, *Treasurer.*

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society; we have also verified its Securities as above mentioned, and find the same to be correct.

January 9, 1905.

J. Mason Allen, C. Lees Curties } *Auditors.*

remark, but it would no doubt be noticed that the amount received as subscriptions was rather less than that of the preceding year, possibly because he had then been rather more pressing for payment of arrears. The investments had been somewhat increased, and the balance in hand was about the same. He should, however, like to call attention to the fact mentioned in the Report, that the losses by death and other causes had not been made up by the number of New Fellows added to the Society during the year, and as it was of great importance to keep up numbers, he hoped the Fellows would do their utmost during the present year to induce as many persons as possible to join the Society.

The adoption of the Report and Balance Sheet having been moved by Mr. Horace Beck and seconded by Mr. Rheinberg, was put to the Meeting by the President, and carried unanimously.

The Scrutineers having handed in the result of the Ballot, the President declared the following gentlemen to have been unanimously elected Officers and Council of the Society for the ensuing year.

President—Dukinfield Henry Scott, M.A. Ph.D. F.R.S. F.L.S.

Vice-Presidents—George C. Karop, M.R.C.S.; The Right Hon. Sir Ford North, P.C. F.R.S.; Henry George Plimmer, F.L.S.; Henry Woodward, LL.D. F.R.S. F.G.S. F.Z.S.

Treasurer—J. J. Vezey.

Secretaries—Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S.; R. G. Hebb, M.A. M.D. F.R.C.P.

Other Members of Council—Jas. Mason Allen; Wynne E. Baxter, J.P. F.G.S. F.R.G.S.; P. T. B. Beale, F.R.C.S.; Conrad Beck; Rev. Edmund Carr, M.A. F.R.Met.S.; A. N. Disney, M.A. B.Sc.; J. W. H. Eyre, M.D. F.R.S. (Edin.); A. D. Michael, F.L.S.; E. M. Nelson; Thomas H. Powell; Julius Rheinberg; Charles F. Rousselet.

Librarian—Percy E. Radley.

Curator—Charles F. Rousselet.

The Chair having been taken *pro tem.* by Dr. Woodward, the President read his Annual Address—the subject of which was an inquiry as to "What were the Carboniferous Ferns." At the commencement of his remarks the President referred to the recent death of Professor B. Renault, the illustrious Palæobotanist, who was only elected an Honorary Fellow of the Society in June 1904. The Address, which was illustrated by a number of lantern slides, as well as by some actual sections, shown on the screen, will be printed in a future number of the Journal.

Mr. A. D. Michael said the Fellows present had already by their applause expressed their appreciation of the excellence of the Address from their President to which they had listened; Dr. Scott was not merely familiar with the group of organisms which he had described, but was regarded as a well-known and eminent authority on the subject he had brought before them. The subject was intensely interesting and had been handled in a masterly manner, and his only regret was

that they would be unable to reproduce in the Journal the very beautiful illustrations which had been shown on the screen. He had great pleasure in moving that their best thanks be given to the President for his extremely able and interesting Address, and that he should be asked to allow it to be printed and circulated in the usual way.

This motion having been seconded by Mr. Vezey, was put to the Meeting by Dr. Woodward, and carried unanimously.

The President expressed his thanks to the Society for having received his Address so favourably. The subject was one of very great interest to those who were engaged in it, although it involved a certain amount of technicality which rendered it a little difficult to present in generally intelligible form to an audience not wholly botanical. He called attention to a number of models exhibited in the room by Mr. Smedley, and to specimens kindly lent by Professor F. W. Oliver in further illustration of the subject.

A vote of thanks to the Honorary Officers and Council for their services during the year was proposed by Mr. Conrady, seconded by Mr. Marks, and unanimously carried.

This was responded to by the Treasurer, who referred to the great amount of work which devolved upon the Secretary, Librarian, and Curator, on whose behalf as well as his own he thanked the Fellows for this token of their appreciation.

A vote of thanks to the Auditors and Scrutineers, was then moved by Mr. Marshall, seconded by Mr. Gardner, and carried unanimously.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. John Rowland Jones, and William John Vandenbergh.

The following Objects, etc., were exhibited:—

The President, in illustration of his Address:—A number of lantern slides and actual sections of fossil plants shown on the screen.

Professor F. W. Oliver:—The following fossil plants, in illustration of the President's Address:—*Alethopteris lonchitica*, *Asterotheca Miltoni*, in fructification; *Dactylotheca plumosa*, barren foliage (this is the form usually described as *Sphenopteris ornata*); *Diplotmema Jacquotii* Zeiller; *Neuropteris heterophylla* (? foliage of a Medullosa); *Sphenopteris affinis*; *S. Aschenborni*.

Mr. H. E. H. Smedley, in illustration of the President's Address:—The following models:—Palæozoic ferns—Crossotheca, pinnule; Dactylotheca, pinnule showing fructification; *Ptychocarpus unitus*, pinnule showing synangia; *Scolecopteris polymorpha*, pinnule; ditto, part of pinnule, transverse section passing through synangium; Sturiella, pinnule showing synangia; ditto, part of pinnule, transverse section passing through synangium; Zygopteris, fructification. Palæozoic seeds; Lagenostoma, longitudinal section; Pachytesta, longitudinal section; Stephanospermum, longitudinal section.

COUNCIL

OF

THE ROYAL MICROSCOPICAL SOCIETY.

ELECTED 18th JANUARY, 1905.

PRESIDENT.

Dukinfield Henry Scott, M.A. Ph.D. F.R.S. F.L.S.

VICE-PRESIDENTS.

*George C. Karop, M.R.C.S.
The Right Hon. Sir Ford North, P.C. F.R.S.
Henry George Plimmer, F.L.S.
Henry Woodward, LL.D. F.R.S. F.G.S. F.Z.S.

TREASURER.—J. J. Vezey.

SECRETARIES.

Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S.
R. G. Hebb, M.A. M.D. F.R.C.P.

ORDINARY MEMBERS OF COUNCIL.

Jas. Mason Allen.
Wynne E. Baxter, J.P. F.G.S. F.R.G.S.
P. T. B. Beale, F.R.C.S.
Conrad Beck.
Rev. Edmund Carr, M.A. F.R.Met.S.
*A. N. Disney, M.A. B.Sc.
J. W. H. Eyre, M.D. F.R.S. (Edin.)
*A. D. Michael, F.L.S.
*E. M. Nelson.
Thomas H. Powell.
Julius Rheinberg.
*Charles F. Rousselet.

* Members of the Publication Committee.

Librarian.—Percy E. Radley.

Curator.—Charles F. Rousselet.

Assistant Secretary.—F. A. Parsons.

ROYAL MICROSCOPICAL SOCIETY.

MEETINGS FOR THE SESSION 1904—1905

AT 8 P.M.

Wednesday, Oct. 19, 1904
„ Nov. 16, „
„ Dec. 21, „
„ Jan. 18, 1905
(*Annual Meeting for Election of Council and Officers.*)
Wednesday, Feb. 15, 1905
„ Mar. 15, „
„ Apr. 19, „
„ May 17, „
„ June 21, „

Fellows intending to exhibit any Instruments or Objects, or to bring forward any Communications at the Ordinary Meetings, will much facilitate the arrangement of the business thereat if they will inform the Secretaries of their intention two clear days at least before the Meeting.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle ($2u$) for Air ($n = 1·00$).	Water ($n = 1·33$).	Homogeneous Immersion ($n = 1·52$).	Limit of Resolving Power, in Lines to an Inch. White Light. ($\lambda = 0·5607\,\mu$) Between D and E.	Monochromatic (Blue) Light. ($\lambda = 0·4861\,\mu$, Line F.)	Photography. ($\lambda = 0·4000\,\mu$, Near Line h.)	Illuminating Power. (a^2.)	Penetrating Power $\left(\frac{1}{a}\right)$
1·52	..	..	180° 0′	137,672	158,845	193,037	2·310	·658
1·51	..	..	166° 51′	136,766	157,800	191,767	2·280	·662
1·50	..	..	161° 23′	135,860	156,755	190,497	2·250	·667
1·49	..	..	157° 12′	134,955	155,710	189,227	2·220	·671
1·48	..	..	153° 39′	134,049	154,665	187,957	2·190	·676
1·47	..	..	150° 32′	133,143	153,620	186,687	2·161	·680
1·46	..	..	147° 42′	132,237	152,575	185,417	2·132	·685
1·45	..	..	145° 6′	131,332	151,530	184,147	2·103	·690
1·44	..	..	142° 39′	130,426	150,485	182,877	2·074	·69[illegible]
1·43	..	..	140° 22′	129,520	149,440	181,607	2·045	·69[illegible]
1·42	..	..	138° 12′	128,614	148,395	180,337	2·016	·70[illegible]
1·41	..	..	136° 8′	127,709	147,350	179,067	1·988	·70[illegible]
1·40	..	..	134° 10′	126,803	146,305	177,797	1·960	·71[illegible]
1·39	..	..	132° 16′	125,897	145,260	176,527	1·932	·719
1·38	..	..	130° 26′	124,991	144,215	175,257	1·904	·725
1·37	..	..	128° 40′	124,086	143,170	173,987	1·877	·729
1·36	..	..	126° 58′	123,180	142,125	172,717	1·850	·735
1·35	..	..	125° 18′	122,274	141,080	171,447	1·823	·741
1·34	..	..	123° 40′	121,369	140,035	170,177	1·796	·746
1·33	..	180° 0′	122° 6′	120,463	138,989	168,907	1·769	·752
1·32	..	165° 56′	120° 33′	119,557	137,944	167,637	1·742	·758
1·30	..	155° 38′	117° 35′	117,746	135,854	165,097	1·690	·769
1·28	..	148° 42′	114° 44′	115,934	133,764	162,557	1·638	·781
1·26	..	142° 39′	111° 59′	114,123	131,674	160,017	1·588	·794
1·24	..	137° 36′	109° 20′	112,311	129,584	157,477	1·538	·806
1·22	..	133° 4′	106° 45′	110,500	127,494	154,937	1·488	·820
1·20	..	128° 55′	104° 15′	108,688	125,404	152,397	1·440	·833
1·18	..	125° 3′	101° 50′	106,877	123,314	149,857	1·392	·847
1·16	..	121° 26′	99° 29′	105,065	121,224	147,317	1·346	·862
1·14	..	118° 0′	97° 11′	103,254	119,134	144,777	1·300	·877
1·12	..	114° 44′	94° 55′	101,442	117,044	142,237	1·254	·893
1·10	..	111° 36′	92° 43′	99,631	114,954	139,698	1·210	·909
1·08	..	108° 36′	90° 34′	97,819	112,864	137,158	1·166	·926
1·06	..	105° 42′	88° 27′	96,008	110,774	134,618	1·124	·943
1·04	..	102° 58′	86° 21′	94,196	108,684	132,078	1·082	·962
1·02	..	100° 10′	84° 18′	92,385	106,593	129,538	1·040	·980
1·00	180° 0′	97° 31′	82° 17′	90,574	104,503	126,998	1·000	1·000
0·98	157° 2′	94° 56′	80° 17′	88,762	102,413	124,458	·960	1·020
0·96	147° 29′	92° 24′	78° 20′	86,951	100,323	121,918	·922	1·042
0·94	140° 6′	89° 56′	76° 24′	85,139	98,223	119,378	·884	1·064
0·92	133° 51′	87° 32′	74° 30′	83,328	96,143	116,838	·846	1·087
0·90	128° 19′	85° 10′	72° 36′	81,516	94,053	114,298	·810	1·111
0·88	123° 17′	82° 51′	70° 44′	79,705	91,963	111,758	·774	1·136
0·86	118° 38′	80° 34′	68° 54′	77,893	89,873	109,218	·740	1·163
0·84	114° 17′	78° 20′	67° 6′	76,082	87,783	106,678	·706	1·190
0·82	110° 10′	76° 8′	65° 18′	74,270	85,693	104,138	·672	1·220
0·80	106° 16′	73° 58′	63° 31′	72,459	83,603	101,598	·640	1·250
0·78	102° 31′	71° 49′	61° 45′	70,647	81,513	99,058	·608	1·282
0·76	98° 56′	69° 42′	60° 0′	68,836	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	67,024	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	65,213	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	63,401	73,152	88,899	·490	1·429
0·68	85° 41′	61° 30′	53° 9′	61,590	71,062	86,359	·462	1·471
0·66	82° 36′	59° 30′	51° 28′	59,779	68,972	83,819	·436	1·515
0·64	79° 36′	57° 31′	49° 48′	57,967	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	56,156	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38′	46° 30′	54,344	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42′	44° 51′	52,533	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	50,721	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	48,910	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	47,098	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	45,287	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	40,758	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	36,229	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	31,701	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	27,172	31,351	38,099	·090	3·333
0·25		21° 40′	18° 56′	22,643	26,126	31,749	·063	4·000
0·20		17° 18′	15° 7′	18,115	20,901	25,400	·040	5·000
0·1[illegible]		12° 58′	11° 19′	13,586	15,676	19,050	·023	6·667
0·1[illegible]		8° 38′	7° 34′	9,057	10,450	12,700	·010	10·000
0·0[illegible]		4° 18′	3° 46′	4,529	5,252	6,350	·003	20·000

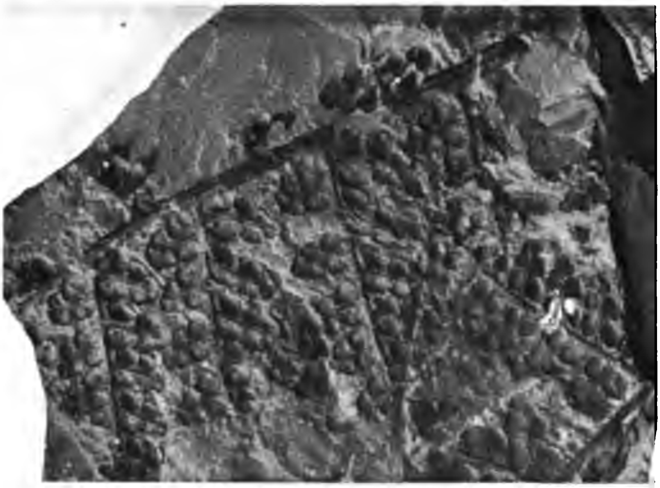

FIG. 1.

FIG. 2.

FIG. 1. Sphenopteris obtusiloba.

FIG. 2. Pecopteris abbreviata.

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APRIL, 1905.

TRANSACTIONS OF THE SOCIETY.

II.—*The President's Address: What were the Carboniferous Ferns?*

By Dukinfield H. Scott, F.R.S.

(*Read January* 18, 1905.)

Plates I. to III.

The Flora of the Carboniferous Period, as commonly portrayed, is characterised by the presence of five great groups of vascular plants: the Equisetales (Horse-tails); the Lycopods (Club-mosses); the Sphenophylls (intermediate in some respects between the two former groups); the Ferns; these four classes have been widely accepted as cryptogamic, spore-bearing plants, though other views have been held, from time to time, as to the position of some of their members. The fifth group was that of the Cordaiteæ, highly organised, seed-bearing trees, to some extent combining the characters of the Conifers and Cycads of the recent Flora, and allied to that isolated species the Maidenhair-tree (*Ginkgo biloba*) of China and Japan.

Of all these groups that of the Ferns, commonly so-called, is by far the most important in number of species, amounting to about half of the total known Flora. Thus Brongniart, in 1849, estimated the whole Palæozoic Flora then known at 500 species, of

EXPLANATION OF PLATE I.

Fig. 1. *Sphenopteris obtusiloba*. Portion of frond, probably of one of the Pteridospermeæ. From a photograph by Mr. W. Hemingway.

„ 2. *Pecopteris abbreviata*. Portion of frond of a Marattiaceous Fern. From a photograph by Mr. W. Hemingway.

which he allotted 250 to the Ferns.* Mr. Kidston, in a more recent enumeration—confined to the British Carboniferous Flora—out of a total of about 330 species, refers about 160 to the Ferns;† the same proportion is approximately preserved in other lists. Such estimates are necessarily very rough, for a fossil "species" is something very different from what we understand by a species (however we may define it) in recent taxonomy; still, as we are only concerned with relative numbers, the proportion given is near enough for our purpose.

If, then, the "Ferns" of the Carboniferous were really Ferns, in the true sense of the word, their numbers would suffice to establish the truth of Brongniart's description of the Palæozoic epoch as the "Reign of the Acrogens,"‡ for, of the remaining groups, the Equisetales and Sphenophylls were no doubt cryptogamic, and the same holds good for a large part, at any rate, of the Lycopods, in spite of recent discoveries of seed-like organs in some of them.

The question I propose to consider this evening is the real nature of the Carboniferous fossil plants commonly described as "Ferns." The great majority of the specimens in question are preserved in the form of the beautiful impressions of "Fern-fronds" familiar to all who have looked through collections of Coal-measure plants; the characters on which such specimens are referred to the Ferns are necessarily derived from the form and venation of the frond, and it is on similar features that their classification has been founded. A few examples of these fronds may be given, taken from four of the largest among the numerous genera under which they have been grouped, namely, *Sphenopteris*, *Pecopteris*, *Neuropteris*, and *Alethopteris*. In all four, as well as in most of the other genera, the fronds were highly compound, the rachis branching repeatedly in a pinnate manner. In *Sphenopteris* (pl. I. fig. 1) the pinnules or leaflets are usually small and lobed, and are contracted at the base, as are also their segments. The venation is acute-angled throughout. The habit of the very numerous species resembles that of members of the genera *Asplenium* and *Davallia* among recent Ferns.

In *Pecopteris* (pl. I. fig. 2), on the other hand, the pinnules have almost parallel margins, and are attached to the rachis by the whole width of their base—a distinct midrib is present, and the lateral veins spring from it at a wide angle. The habit is most nearly represented at the present day among the Cyatheaceæ, or Tree-ferns.

In *Neuropteris* (pl. II. fig. 3) the leaves, often of gigantic size,

* "Tableau des Genres de Végétaux Fossiles," in Dictionnaire Universel d'Hist. Nat. Paris, 1849.

† "Divisions of British Carboniferous Rocks, as determined by Fossil Flora," Proc. R. Phys. Soc. Edinburgh, xii. (1893–4).

‡ A name in use at that time for the Vascular Cryptogams, or Pteridophyta.

have large, ovate, or oblong pinnules, somewhat cordate at the base, and often attached to the rachis by a short stalk. The midrib is distinct to near the end of the pinnule, where it breaks up into small veins; the angles between the veins are acute throughout. The leaves are often much like those of an *Osmunda*, but in some cases bear peculiar leaflets on the main rachis, differing from the ordinary pinnules.

Alethopteris, also a genus of very large, repeatedly-pinnate fronds, is characterised by the broad decurrent base of the thick oblong pinnules, the margins of which are strongly incurved towards the lower surface. There is a midrib throughout, and the angles between the veins are wide. There is a resemblance to species of *Pteris* in some points, while the general appearance of the enormous fronds may have been like that of *Angiopteris*, among the Marattiaceæ.

Now in all these cases—and the same holds good for the many other genera commonly considered as Ferns—there is no doubt as to the thoroughly Fern-like nature of the fronds. That, however, is not enough. There are some plants, even among Dicotyledons of the present day, with foliage simulating that of Ferns, while in the family of Cycads, which is more to the point here, there is the often-quoted case of *Stangeria*, which, when first brought to Europe from South-East Africa, was actually placed by botanists in *Lomaria*, a well-known genus of Ferns,* until its cones appeared and revealed its true nature.

Other evidence than frond-characters had to be sought in order to show what the Carboniferous "Ferns" really were. If we ask what we mean botanically by a *Fern*, the answer must be, that above everything else we mean a plant with a certain type of reproduction and life-history. To take a common example: in the Male Fern, familiar to everyone, we find that the asexual sporangia, containing the spores, are borne in definite clusters, or sori, on the back of the frond, and that each sporangium has a ring, or annulus, of enlarged cells, by which its opening is effected when the spores are to be shed. The spores germinate, under suitable conditions, and each produces a small green organism, the prothallus, on which the sexual organs are borne; fertilisation takes place by means of the actively swimming male cells, or spermatozoids, and an embryo is the result, which grows up into a new Fern-plant, producing spores in its turn—and so the cycle is completed.

In the case of fossil plants we can rarely expect to find traces of a delicate structure such as a Fern-prothallus, but we can and do find evidence as to the nature of the sporangia. In a certain number of the Carboniferous plants called Ferns the asexual organs have been found, and have proved to be true Fern-fructifications.

* Under the names *Lomaria coriacea*, *L. eriopus* Kuntze, and *L. lagopus* T. Moore.

Our knowledge of these is due to the work of many investigators, among whom the late Dr. Stur, of Vienna, and my friends, Professor Zeiller, of Paris, and Mr. Kidston, of Stirling, must be specially mentioned.

On fronds of the genus *Pecopteris*, in particular, we find very characteristic fructifications, with the sporangia ranged in definite sori, the members of which are often more or less fused together, and are usually without a typical annulus. Such fructifications are characteristic of the small tropical family Marattiaceæ among recent Ferns, a group which evidently played a much more important part in Palæozoic times. The modern Marattiaceæ are often large handsome Ferns, but not so large as their ancient allies, which attained the stature of trees. The anatomy of their tall stems is known in many cases (the numerous species of *Psaronius*), and proves to have been extremely complex, entirely Fern-like in character, and resembling that of recent members of the Order Marattiaceæ. Thus the anatomical evidence strongly supports the conclusions drawn from the reproductive organs, and there can be no doubt that in many, at least, of the species of *Pecopteris*, we have to do with true Ferns, referable to a definite living family. Among the fructifications the type with circular sori, now only represented in the genus *Kaulfussia*, was common in the Carboniferous Marattiaceæ, as in the groups *Asterotheca*, *Scolecopteris*, and *Ptychocarpus* (fig. 32), genera founded on reproductive characters, and distinguished in part by the degree in which the sporangia of a sorus were united to one another. Among the *Pecopteris* fronds there were others which bore fructifications less clearly Marattiaceous, but in none of them is there anything to oppose the inclusion of the plants among the Ferns. In the case of *Senftenbergia* the sporangia recall those of the recent Schizæaceæ, of which the Climbing Ferns (*Lygodium*) are familiar examples. The fructification known as *Oligocarpia*, resembling that of Gleicheniaceous Ferns, occurs on fronds both of the *Pecopteris* and the *Sphenopteris* type. At least eleven genera of fructifications have been referred to the fronds of different species of *Sphenopteris*. Some of these were no doubt really the reproductive organs of Ferns, as *Oligocarpia* and *Corynepteris*; others, as *Urnatopteris*, are doubtful; while some, as *Crossotheca* and *Calymmatotheca*, were in all probability of a totally different nature.

Good examples of typical Fern-fructification are often met with

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EXPLANATION OF PLATE II.

Fig. 3. *Neuropteris heterophylla.* Portion of frond, slightly enlarged.

„ 4. Seed of the same plant, showing two characteristic pinnules, attached to the stalk bearing the seed. × 2 diam. Figs. 3 and 4 from photographs kindly supplied by Mr. R. Kidston, F.R.S.

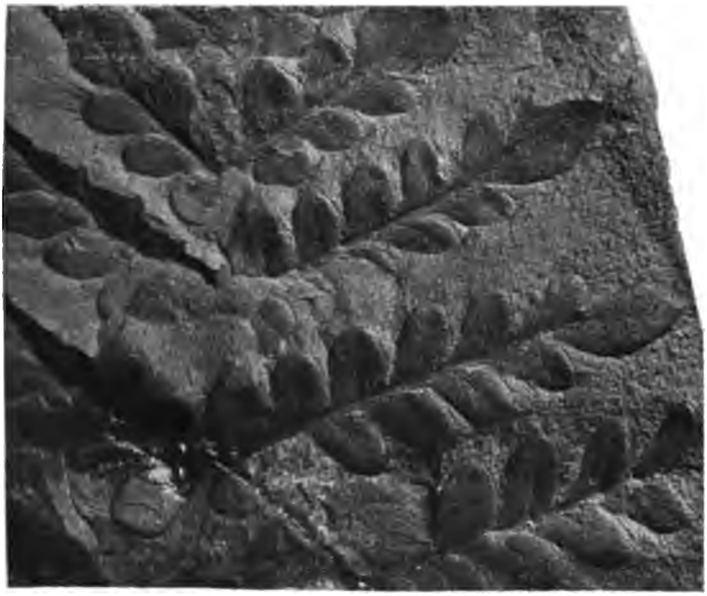


FIG. 3.

FIG. 4.

FIG. 3. Neuropteris heterophylla, frond.

in the petrifactions from the English Coal-measures. In one form, very common in certain localities, the sporangia, which occur in crowded sori on Sphenopteroid leaflets, have a most distinct annulus, suggesting that of an ordinary Polypodiaceous Fern, but usually two cells in width (pl. III. fig. 7).

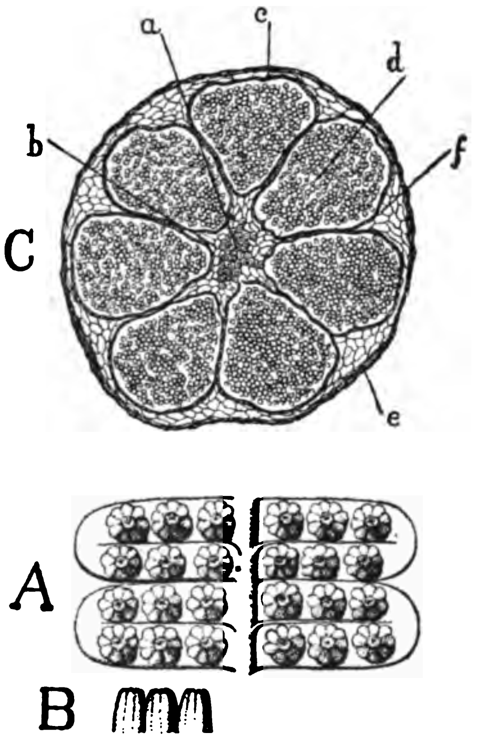


FIG. 32.—*Ptychocarpus unitus*, showing Marattiaceous fructification. A, Part of lower surface of fertile leaflet, showing numerous sori or synangia. B, Synangia in side-view. A and B × about 6. After Grand'Eury. C, Transverse section of a synangium, showing seven sporangia united in a ring. *a*, vascular strand; *b*, cellular tissue of central column to which the sporangia are attached; *c*, tissue lining sporangia; *e*, *f*, enveloping tissue. × about 60 diam. After Renault. From the Upper Coal-measures of France.

Another interesting indication of the presence of true Ferns in the Carboniferous Flora is afforded by the case of a petrified sporangium, in which the spores are preserved at various stages of germination, agreeing closely with the corresponding stages of development in recent Ferns, among which germination within the sporangium is by no means uncommon. In this instance, then, we

have a real case of the preservation of Carboniferous Fern-prothalli, though their career was cut short early.*

The proportion of Carboniferous "Fern-fronds," however, in which there is any evidence of Fern-fructification, is not, after all, very large. Out of 147 species of such fronds enumerated in Mr. Kidston's list above referred to, there are only 27 which we can attribute with any certainty to true Ferns, on the ground of fructification. Of the remaining 120, 75 are still altogether doubtful, while in 45 the probability, for reasons to be stated immediately, is all on the side of an affinity with seed-bearing plants.

In the case of a large proportion of the fronds in question, no fructification had been found until within the last few years. Out of the twenty principal frond-genera,† there is only one, *Pecopteris*, which consistently gives evidence of Fern affinities by its reproductive characters. In the great genus *Sphenopteris* a fraction only of the species is known to have borne the fructification of Ferns. In a few other genera, notably *Rhacopteris* and *Palæopteris*, reproductive organs have been found, and regarded as those of Ferns, but their real nature is dubious. In fourteen entire genera, including some of the largest and best known, as *Alethopteris* and *Neuropteris*, referred to above, there has never been any evidence worth consideration of a fructification which could be referred to Ferns. Yet in cases where such fructification occurs—as in the species of *Pecopteris*—it is not uncommon, being found, according to Mr. Hemingway, an experienced collector, in about 25 p.c. of the specimens, so that its constant absence from the fronds of a common species affords a strong presumption that the reproduction was not of the ordinary Fern-type. On these negative grounds, the Austrian palæobotanist Stur, in 1883, definitely expressed his opinion that these fronds, which had never been found with any Filicinean fructification, could not belong to the Ferns, and consequently excluded the genera *Neuropteris*, *Alethopteris*, *Odontopteris*, and others, as non-ferns, from consideration in his memoir.‡ Stur's opinion has been amply justified by the event, but negative evidence by itself can lead to no more than negative conclusions.

It was from anatomical data that the first positive indication of the real nature of these quasi-ferns was obtained. Three months ago I had the honour of bringing before the Society one of the most important cases of this kind, that of *Lyginodendron old-*

* Scott, "Germinating Spores in a Fossil Fern Sporangium," New Phytologist, iii. January 1904.

† *Adiantites*, *Alethopteris*, *Callipteridium*, *Callipteris*, *Cardiopteris*, *Diplotmema*, *Eremopteris*, *Linopteris*, *Lomatopteris*, *Lonchopteris*, *Mariopteris*, *Megalopteris*, *Neuropteris*, *Odontopteris*, *Palæopteris*, *Palmatopteris*, *Pecopteris*, *Rhacopteris*, *Sphenopteris*, *Tæniopteris*.

‡ "Zur Morphologie und Systematik der Culm- and Carbonforme," SB. d. K.K. Akad. d. Wiss. zu Wien, Bd. lxxxviii. (1883) p. 638.

hamium,* in which the anatomical structure showed that the plant was something else than a true Fern, long before any satisfactory evidence as to the fructification was obtained. The anatomical characters indicated a position intermediate between the Ferns and the Cycads, a family of naked-seeded Phanerogams which still retains some Fern-like traits. In this case of *Lyginodendron* we further found that the conclusions drawn from the vegetative structure had since been more than confirmed by the observation, due originally to Professor F. W. Oliver, that a previously unassigned seed, *Lagenostoma Lomaxi*, presents structural features identical with those of the *Lyginodendron*, with which it occurs in constant association, while they are unknown in any other plant. The evidence from structure, combined with that from association, appears to leave no doubt that in this case a species with perfectly typical Fern-foliage, of the *Sphenopteris* type, was nevertheless a seed-bearing plant. The seeds of *Lyginodendron* are not rudimentary, but highly differentiated, and almost on the same level of organisation as those of living Cycads.†

There are other species of *Lagenostoma* so closely allied to the seed now referred to *Lyginodendron oldhamium*, that it is certain that they too must have belonged to members of the same Fern-like family. We will take two examples, both from the Lower Coal Measures of Scotland, about to be fully described by Mr. Newell Arber.‡ The seeds in question, to which the names *Lagenostoma Sinclairi* and *L. Kidstoni* have been given, are only known as yet in the form of casts, but they agree in important characters with the species in which the structure is preserved. In *Lagenostoma Sinclairi*, the seed, like that of *Lyginodendron oldhamium*, is enclosed in a husk or cupule. These organs are borne on the branches of a naked rachis, which can scarcely be interpreted otherwise than as the reduced, fertile frond of some Fern-like plant.

In the other species, *L. Kidstoni*, there is no decisive evidence for the presence of a cupule; the characters of the seed, which is conspicuously lobed at the micropylar end, show it to be a true *Lagenostoma*. The seeds occur in great numbers on the surface of a large slab, which is traversed in all directions by a branched rachis, to the finer ramifications of which the seeds appear to have been attached. Everything indicates that both these seeds were borne on a frond of the *Sphenopteris* type, modified, as is so often the case among the Ferns themselves, in relation to its function as the bearer of reproductive organs.

* Journ. R. Micr. Soc., Dec. 1904, Proceedings, p. 725.

† Oliver and Scott, "On the Structure of the Palæozoic Seed *Lagenostoma Lomaxi*," Phil. Trans. R.S. (B) cxcvii. (1904) p. 193.

‡ In the Proceedings of the Royal Society, 1905.

In connection with the fossils just described, we may recall the old observation of Stur* that *Sphenopteris Stangeri*, a species scarcely distinguishable from the foliage of *Lyginodendron oldhamium*, possessed fertile fronds with a naked rachis bearing cupule-like organs; these may either have once contained the seeds, as in our species, or may have enveloped the unknown pollen-sacs.

From the evidence afforded by *Lyginodendron* and supported by the other cases mentioned, the conclusion must be drawn that in certain species with the foliage of *Sphenopteris* the fructification was not that of a Fern but of a seed-plant with Gymnospermous affinities.

In other species of *Sphenopteris* (*S. elegans*, *S. Linkii*, *S. dissecta*) we know that the stem on which the fronds were borne was a *Heterangium*; this type of stem, occurring in a petrified condition, has been thoroughly investigated anatomically, and has so much in common with the structure of *Lyginodendron* as to leave no doubt of its near affinity with that genus.

On the whole of the evidence, then, we find that under the name *Sphenopteris* a heterogeneous assemblage is collected, including a certain number of true Ferns, as shown by their fructification, but including also a considerable group of plants which had already entered the ranks of the Spermophyta.

We will now pass on to a different family—that of the Neuropteridese, including *Neuropteris*, *Alethopteris*, *Odontopteris* and other genera, among which are many of the most familiar "Fern-fronds" of the Coal flora. From the work of the late illustrious palæobotanist, M. B. Renault, of Paris, we know that the fronds of both *Alethopteris* and *Neuropteris* belonged to the petioles named *Myeloxylon*, which are often found in the petrified state, and show a structure remarkably like that of the leaf-stalk of a Cycad.

* "Culmflora," Abhandl. d. K.K. Geol. Reichsanstalt, Bd. viii. 1875–7.

EXPLANATION OF PLATE III.

Fig. 5. *Trigonocarpon olivæforme*. Longitudinal section of seed. *s*, *s*, fleshy outer layer of testa; *e*, inner hard layer of the same; *m*, micropyle: inside the seed the outlines of the contracted nucellus and of the embryo-sac can be traced. × nearly 4 diam. Scott Collection, 940. From a photograph by Mr. L. A. Boodle.

„ 6. *T. olivæforme*. Transverse section of seed, showing the twelve angles of the testa, of which three are more prominent than the rest. *s*, *e*, the two layers of the testa, as in fig. 5. The outlines of the nucellus and embryo-sac are distinct. × nearly 4 diam. Scott Collection, 325. Hough Hill, Lower Coal Measures. From a photograph by Mr. L. A. Boodle.

„ 7. Section of an annulate Fern-sporangium containing spores. *a*, annulus consisting of enlarged cells, with rather thick walls. On the opposite side of the sporangium the cells are much narrower, with thinner walls. × about 80 diam. Dulesgate, Lower Coal Measures. From a photograph by Mr. L. A. Boodle.

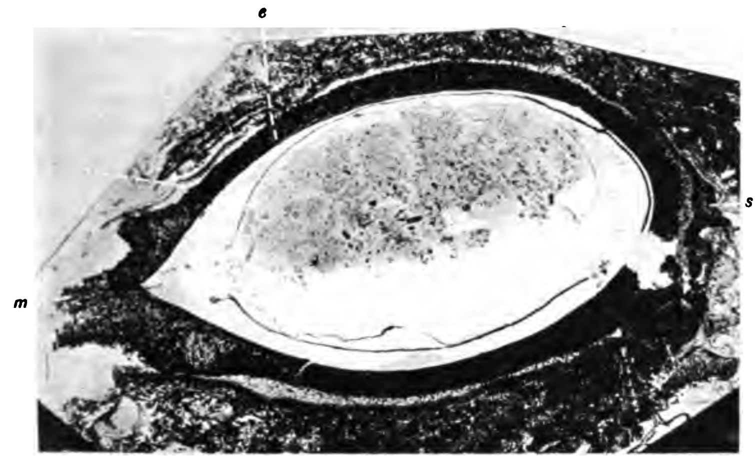


FIG. 5.

FIG. 6.

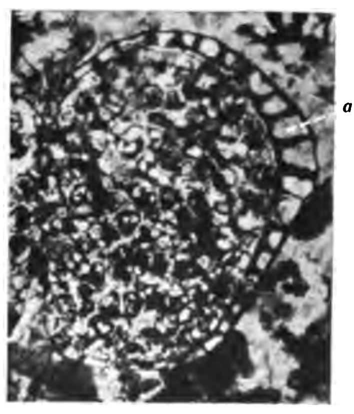


FIG. 7.

FIGS. 5, 6. Trigonocarpon olivæforme.

FIG. 7. Annulate Fern sporangium.

Weber and Sterzel have shown that these petioles, in their turn, were borne on the stems known as *Medullosa*. This is well seen in the English species (*Medullosa anglica*) where the leaf-bases attached to the stem show the typical structure of a *Myeloxylon.*

The organisation of the stem is peculiar, for it contains several distinct vascular cylinders, thus resembling the stem of the more complex Ferns, but each of these cylinders grew in thickness on its own account, by means of a special cambial layer—a combination of characters not known in any living plant. While the primary structure of the stem was Fern-like, the secondary tissues resembled those of Cycads, as was also the case with the structure of the petiole; the form and venation of the leaves, however, take us back once more to the Ferns. In the case of the English *Medullosa* the foliage was that of an *Alethopteris.* Owing to these indications of affinity in two directions, the family Medulloseæ, or Neuropterideæ (for the names may be treated as synonymous), have been classed of late years in the intermediate group Cycadofilices.* Thus Stur's exclusion of these plants from the true Ferns has been justified by anatomical evidence.

Suggestions as to the probable fructification were made in 1898 and 1900 by Hemingway and Wild, the former relying on the association of the fronds with certain unassigned seeds, while the latter called attention to some points of structural similarity between one of these seeds, *Trigonocarpon*, and the petioles of *Medullosa*, with which it constantly occurs in association. The connection, however, of these seeds with the Neuropterideæ remained doubtful, though very probable, until strengthened by Mr. Kidston's striking discovery, in 1903, of a large seed in actual continuity with the pinnules of a well-known species of *Neuropteris*, *N. heterophylla*, the most impressive example of a "seed-bearing Fern" which has yet been brought to light † (pl. II. fig. 4). From the nature of the preservation it has not been possible to examine the structure of the seed of *Neuropteris heterophylla*, but that of *Trigonocarpon* is well known, at least in its main features. The body of the seed is oval, attaining an inch in length; it bears twelve longitudinal ridges, of which three are more pronounced than the rest, and have thus given the genus its name.‡ The ridges belong to the hard fibrous inner layer of the seed-coat; this was enveloped by a fleshy outer coat, of considerable thickness, bounded by a well-marked epidermis. The fleshy outer testa is only well preserved in the best of the petrified specimens (see pl. III. figs. 5 and 6). Favourable specimens further show that the

* Scott, "Studies in Fossil Botany," 1900, p. 374.

† Kidston, "The Fructification of *Neuropteris heterophylla*," Phil. Trans. R.S. (B), cxcvii. (1904) p. 1.

‡ The ordinary three-cornered specimens, however, are merely structureless casts of the *inside* of the seed.

micropyle was a long tube, exceeding the body of the seed in length, and flanked by a broad wing, continuous with the outer layer of the testa (fig. 33).

Everything now points to the conclusion that the Medulloseæ, or Neuropterideæ, generally were seed-bearing plants. M. Grand'Eury's recent observations on the distribution of these fossils are of great interest in their bearing on this question.* This distinguished French palæobotanist has an unrivalled knowledge

FIG. 33.—*Trigonocarpon Parkinsoni.* Cast of seed-cavity, with long micropylar canal. × 1¼ diam. From Barnsley, Middle Coal Measures. Kidston Collection, 1062. (From a sketch by Miss Janet Robertson; kindly lent by Professor F. W. Oliver.)

of the coal-plants as they occur *in situ* in the mines. By his researches on the mode of occurrence of the fossil plants in the coal-fields of St. Etienne and other districts, he has been led to the conclusion that *Alethopteris*, *Neuropteris*, *Odontopteris*, *Linopteris*, and others, bore seeds, and that they were primitive Cycadinæ with the fronds of Ferns. About St. Etienne, the Neuropterideæ and their allies form in bulk about one-seventh of the fossil vegetation, and usually occur in groups by themselves, separate from the groups

* Grand'Eury, "Sur les Graines des Neuroptéridées," Comptes Rendus, cxxxix. (1904) pp. 23, 782.

made up of Lycopods, Calamites, and Cordaiteæ. Seeds rarely occur except in association with the Cordaiteæ or the Neuropterideæ; with the former the flattened bilateral seeds are found, with the latter are associated the round or oval seeds, such as *Trigonocarpon* and *Pachytesta*. Where the Neuropterideæ are richly represented, the seeds accompanying them are numerous and varied; different kinds of seeds occur in association with the different genera, and no other fronds than those of Neuropterideæ occur with the seeds. Various species of *Alethopteris*, *Neuropteris*, *Odontopteris*, and *Linopteris*, have their special seeds associated with them. It is interesting to note that the seeds associated with some species of *Alethopteris* are of the same type as our *Trigonocarpon*, confirming the conclusion of Wild above referred to. As one would naturally expect, it is in cases where the plants occur *in situ*, or not far off from their place of growth, that we find the seeds associated with them.

These observations, begun in the Upper Coal-measures of St. Etienne, have since been extended, with similar results, to the Middle Coal-Measures of the Liége district. As the seeds would naturally have been shed when ripe, it is not surprising that M. Grand'Eury has hitherto only found immature seeds, not readily to be identified, in actual connection with the rachis. In any case, this investigator's extensive observations on association materially confirm the more definite evidence from continuity and comparative structure already brought forward. M. Grand'Eury points out that there are a great number of seeds still unassigned, even exceeding in variety the fronds with which they are associated. A rich field is thus opened up for further investigation.

Within the last fortnight a communication has reached us from America, showing that the evidence for the existence of "seed-bearing Ferns" is no longer limited to this side of the Atlantic. Mr. David White, the well-known Washington palæobotanist, has discovered, in a species of *Aneimites* (otherwise *Adiantites*) from the Lower Carboniferous of America, organs attached to the frond, which he interprets as winged seeds.* My friend Mr. Newell Arber has pointed out to me the great resemblance which exists between the supposed seeds of *Aneimites* and certain seeds observed by him which he finds associated with the fronds of a similar genus *Eremopteris*, from our own Coal-measures. After examining the specimens of the latter with Mr. Arber in the collection of the British Museum, I was led to believe that Mr. White's interpretation of the bodies in his *Aneimites* as seeds is probably correct; there can be no doubt, from his figures, that they are borne on the frond. It thus appears that Mr. White has

* D. White, "The Seeds of *Aneimites*." Smithsonian Miscellaneous Collections xlvii. part 3 (Dec. 1904).

discovered another striking case of an apparent Fern-frond bearing the reproductive organs characteristic of Phanerogamic plants.

If we now sum up the results of our rapid survey, we find that among the Carboniferous plants commonly described as Ferns, a certain number, but, as appears probable, only a minority, were really of that nature, as shown by their Filicinean fructification. Among these true Ferns the Marattiaceæ were largely represented; other families also existed, though probably not identical with any of the groups now living.

The investigations of the last few years indicate, however, that of the Fern-like plants of that period, a large number, probably the majority, were not, properly speaking, Ferns at all, but seed-bearing plants, most nearly allied to such recent Gymnosperms as the Cycads, while at the same time retaining some of the characters of their cryptogamic allies.

It is probable that a certain number of the fossils hitherto interpreted as the fructifications of Ferns, will turn out to be the pollen-bearing organs of the fern-like seed-plants, or Pteridospermeæ, as we now call them. This is a part of the subject on which much light may be expected to be thrown by further investigation, but which is as yet hardly ripe for discussion.

In conclusion, a little more may be said about the family Cycadaceæ, which in the recent Flora most nearly represents the fern-like seed-plants which played so important a part in Palæozoic times. They are by no means numerous at the present day, including only nine genera with about seventy species, scattered over the tropical and sub-tropical zones of both the Old and New worlds. During the intervening Mesozoic period, however, the Cycads and their allies held a dominant position, forming a large part of the vegetation of the globe in all latitudes.

The fern-like habit of some of the recent Cycads has been already referred to; it may be added that in many of them either the leaf or its pinnæ are circinately coiled in the bud, as in Ferns.

Some of the Cycads, as in the genera *Cycas* and *Encephalartos*, attain the dimensions of small trees, reaching about 20 feet in height. The large pinnate leaves (bi-pinnate in the Australian genus *Bowenia*) bear a superficial resemblance to those of Palms.

Cycas, the type genus, differs from the rest of the family in the structure of the leaflets, each of which is traversed by a midrib only, while in the other genera the venation is more complex and fern-like. *Cycas* is, moreover, of special interest from the character of the female inflorescence. No female cone is produced, but a rosette of leaf-like carpels appears on the main stem in place of the ordinary leaves, and after flowering, the normal vegetative growth of the axis is resumed. The carpels, which bear from two to six ovules each, are lobed and foliaceous in the commonly cultivated species *C. revoluta*, while in *C. circinalis* and others they are more

reduced. The seeds, even if unfertilised, may attain the size of large plums, and from their bright colours are conspicuous objects.

In bearing the seeds on leaves comparatively little modified, *Cycas* approaches nearest of any living plants to the Palæozoic Pteridosperms, where, as we have seen, all the evidence points to the seeds having been developed on the rachis of the frond.

In the other genera of Cycadaceæ the carpels are more specialised, bearing two marginal ovules each, and are grouped in definite terminal cones.

Throughout the family the male sporophylls or stamens are borne in cones; each stamen produces numerous pollen-sacs on its lower surface, which are grouped in sori like the sporangia of Ferns. The seeds of Cycads agree closely with those of the fossil Pteridosperms in many respects. Here we need only mention the possession of a pollen-chamber, an excavation in the tip of the nucellus or central body of the ovule, in which the pollen-grains are received, and in which their germination takes place. The presence of this organ was first discovered and excellently illustrated by our countryman Griffith, as long ago as 1854.* As we saw in the case of *Lagenostoma*, the pollen-chamber is a conspicuous feature in the structure of Pteridospermous and other Palæozoic seeds.

The fact that in the Cycadaceæ, as also in the Maidenhair Tree, fertilisation is effected by means of actively moving spermatozoids, as in Ferns and other Cryptogams, was discovered by the two Japanese botanists Ikeno and Hirase in 1896, and independently confirmed by the researches of Webber, in America. The proof thus afforded that in their method of fertilisation these lower Gymnosperms are exactly intermediate between the Cryptogams and the higher seed-plants, is one of the most striking contributions to our knowledge of the evolution of plants, and harmonises well with the conclusions we have drawn from a study of the Palæozoic forms.

Of all living seed-plants the Cycads stand nearest the Ferns among Cryptogams. The Pteridosperms of the Palæozoic era, however, approached the latter much more closely still, and appear to afford convincing evidence of the descent of the Gymnospermous seed-plants from ancestors of the same stock with the Ferns.

* Icones Plant. Asiat., part 4, pls. 377 and 378; Notulæ ad. Plant. Asiat., 1854, pp. 6–8.

NOTES.

An Experimental Proof of Phase-Reversal in Diffraction-Spectra.

By A. E. Conrady, F.R.A.S., F.R.M.S.

In the paper which I read at the November Meeting on microscopical theories, I supplied the mathematical proof of an important theorem applicable to gratings, and showed how this theorem explained the formation of correct images of gratings by means of the light diffracted by them.

As that proof, being mathematical, is not likely to appeal to the majority of practical microscopists, and as some of these may have been misled by the attack which has been directed against the validity of that proof, I have much pleasure in describing and showing a convincing *experimental* proof of the theorem in question.

In my paper I showed *theoretically* that the second spectrum was the lowest which was subject to phase-reversal, and I pointed out in detail how the reversal occurred as soon as the width of the slit exceeded the width of the dark interval, and how this reversal of phase accounted for the relative width of the slits being correctly shown as soon as the second spectrum was admitted. I moreover pointed out that, owing to the preponderance of the direct light and of the first spectrum, the slits were always shown in their correct position, i.e. coincident with the ideal geometrical image, and that the admission of the second spectrum merely altered the width of the lines in the image in the proper direction. It should be borne in mind that all these deductions were purely theoretical, for I had not had an opportunity—and, indeed, had not sought for one—to try the experiment. I *wanted* to prophesy from theory what should happen. In deference to the leading idea of my treatment of the Abbe theory, viz. to limit myself to *normal working conditions*, I did *not* discuss what would happen if the direct light were cut off, and the image formed by the first and second spectrums only, as would occur if dark-ground illumination were adopted. Now it is easy to extend the deductions in this direction. I showed in the original paper that, with relatively narrow slits, the direct light and the light of the first and of the second spectrum would *all* arrive at the centre lines of the geometrical images of the slits in the same phase; hence it follows that the exclusion of the direct light would leave the two spectra still meeting in equal phases, and producing a maximum of brightness along the same

centre lines, and the lines would, therefore, be shown in exactly the same position, and otherwise, also, much the same as before. But I also stated in the paper that with relatively broad slits the second spectrum arrived at the same points in the *opposite* phase, but could not reverse the result of the direct light and of the first spectrum, owing to the comparative weakness (under these conditions) of the light of the second spectrum. But if in *this* case the direct light were blotted out, it is at once apparent that the remaining two spectra would meet in the centre-lines of the geometrical images of the slits *opposed* to each other in phase. They would, therefore, come to complete interference, and produce practical darkness where there was maximum brightness before; and, in accordance with the general theory of interference, they should produce maximum brightness where, in the presence of the direct light, there was practically complete darkness. In other words, the change from direct to dark-ground illumination should cause the lines in a grating of relatively broad slits to *change their position by half an interval.*

These were the conclusions which quite recently I put before Mr. Rheinberg when he happened to call on me, and I was delighted to hear that he had the instrument and the gratings that should enable us to submit my theory to the test of actual experiment.

The instrument referred to is Abbe's "Demonstration Microscope," and the grating which was selected for the experiment is a "reciprocal" one, i.e. one having relatively narrow slits in one half, relatively broad slits in the other half, the interval from centre to centre of the slits being the same in both rulings. It is, therefore, an ideal object for this crucial experiment, inasmuch as it presents the two cases side by side in the same field, and under precisely the same conditions.

It is as gratifying to myself, as it must be disconcerting to the gentleman who tried to disprove my theoretical conclusions, that the latter are borne out by experiment to the fullest possible extent, for—

1. The admission of the second spectrum brings out the relative width of slit and dark interval, in accordance with my theory and true to nature.

2. The surprising result predicted by theory duly follows when, in the presence of the first *and* second spectrum, the direct light is cut off.

The bright lines forming the images of the relatively narrow slits retain their position, and are only *slightly affected* in the direction of a moderate change in width and brightness, *but* the lines forming the images of the relatively broad slits immediately change their position, so as to appear where the dark interval was before, exactly as had been deduced theoretically.

It will, no doubt, prove a difficult matter to maintain the

objection to my theorem in the face of this striking, and indeed startling, experiment.

While experimenting in Mr. Rheinberg's laboratory, and by the exercise of some patience and discrimination, we were able to confirm theory in yet another and equally convincing manner by means of the same grating. It is a simple deduction from my theory, that if by any process we could *reverse* the phase relation of the second spectrum to the direct light and to the first spectrum, the relative width of the lines should be shown the *reverse* of truth, i.e. the narrow lines should appear broadened out, whilst the broad ones should be sharpened up. By careful use of the "compensator" we were able to produce this effect also; but, as in the present form of the compensator the experiment is a delicate one, and the proper conditions easily upset, I defer the demonstration for a future occasion, as I am naturally anxious not to provide any opportunities for the misrepresentation of facts or the raising of false issues, such as would be afforded by disturbing the theoretically necessary adjustments.

In conclusion, I might point out that I have recently discovered that phase-reversals of the kind which I have dealt with in my paper, and the importance of which for the full explanation of microscopical images has been there insisted upon, have been found many years ago by Sir George Airy and by Schwerd, in connection with numerical determinations of the amplitudes of diffracted light; but as, from their point of view, the phase of the diffracted light was immaterial—the intensity being the quantity sought—no importance was attached to it, and no attention called to this interesting fact, which would, indeed, seem to have been completely lost sight of until now.

The Influence on Images of Gratings of Phase-Differences amongst their Spectra.

By Julius Rheinberg.

Plate IV.

The accompanying photographs, taken with the Abbe Demonstration Microscope, afford some experimental evidence of the results brought out by Mr. A. E. Conrady's development of the theory of microscopic vision.

The following is, I think, a simple method of regarding those results, which will assist in understanding the photographs.

FIG. 1.

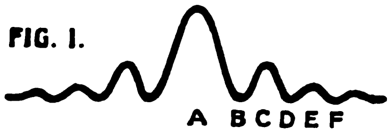


FIG. 2.

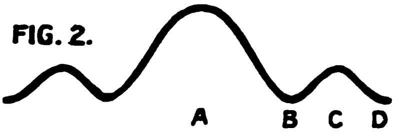


FIG. 3.

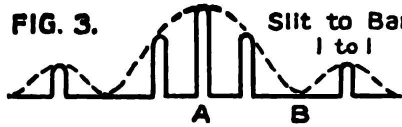


FIG. 4.

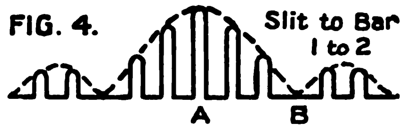
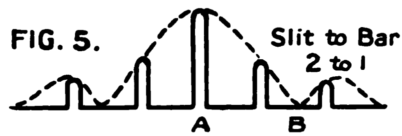


FIG. 5.



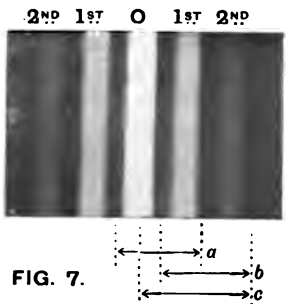
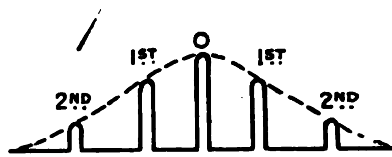


FIG. 7.



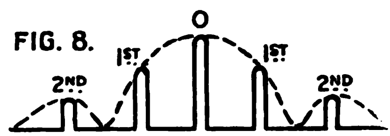


FIG. 8.

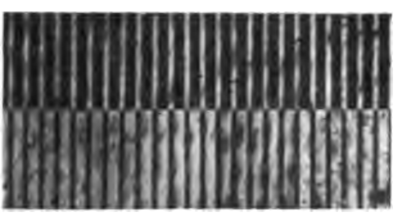


FIG. 6

FIG. 9.

FIG. 10.

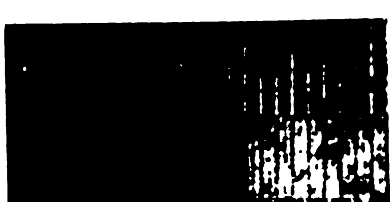


FIG. 11.

The theory of diffraction teaches us that in a regular grating, in which the slits are all of equal width, we need only draw the light-intensity curve for one of the slits to be able to indicate immediately the positions and relative intensities of the spectra or maxima of the grating as a whole.

The intensity curve for one slit may be represented by figs. 1 and 2.* From the highest point at the centre, A, it falls to zero at B, and then alternately rises and falls. This indicates that in the diffraction pattern which the slit forms, the points A, C, E will be the middle of bright bands, the points B, D, F the middle of dark bands. The width of the bands depends upon the width of the slits, being in inverse ratio. Thus, fig. 2 shows the intensity curve for a slit half as wide as that of fig. 1.

When, as in a regular grating, we have more slits than one, all of the same width, all that we require to know to find the position of the maxima of the grating is the relative width of the slits to the bars, for the first maximum will occupy a position on A B (i.e. the distance between the centre of the middle bright band and that of the first dark band), such that its distance from A and B respectively is in the same ratio as the width of the slits to that of the bars. Thus, if the slits just equal the bars in width, the first maximum will be equidistant from A and B (fig. 2); if the slit is half as wide as the bars, it will be half as far from A as from B (fig. 3); if twice as wide as the bars, it will be double as far from A as from B (fig. 4); and so forth. Having found the distance of the first maximum from A, we may mark off the same distance for all the succeeding maxima, and it will be seen that as a necessary corollary there are always just as many maxima formed between A and B as the number of times the width of the bars divided by that of the slit shows. Intermediate between the maxima of the grating there will, of course, be the minima.

The relative light-intensities of the maxima produced by the grating depend on where they happen to fall with respect to the intensity curve of their single slits, because they lie on a similar curve. Thus, in figs. 3, 4, and 5, it will be seen that the relative intensities of the maxima are just the same as for the corresponding points on the single-slit † intensity curves, indicated by the dotted lines.

Now the point brought out by Mr. Conrady is, that in the case of a single slit a change of half a phase-period occurs at each point of zero intensity, and that the maxima from the grating, wherever

* All the intensity curves shown in the figures are diagrammatic, their purpose being merely to illustrate matters brought forward in this Note, and reasons of space having precluded their being drawn to scale.

† This holds good even where a maximum happens to fall on a point where the single-slit curve shows zero intensity, for then the particular maximum in question is absent.

they happen to fall with respect to the intensity curve of the single slit, will show a corresponding change of phase.

Thus, not only are the relative intensities of the maxima determined by the intensity curve of the single slit, but we may also draw certain conclusions from the same as to their phase.

When, as in a Microscope, using parallel light from the condenser, we have the spectra produced by the object grating formed in the back focal plane of the objective, we can detect any change of phase from the normal by an alteration of the position of the lines in the image or view-plane. By normal phase-difference I mean that difference which occurs in consequence of the position of the grating in the object-plane, and which is the cause of the images of the lines being formed at the points where, according to geometrical optics, they should be formed.*

When the position of the grating on the Microscope stage is such that one of its *slits* is situated symmetrically on the axis of the Microscope, this phase-difference is nil; when it is situated so that one of the *bars* is situated symmetrically on the optical axis, the normal difference between two spectra would be half a phase-period. It is essential, however, not to confuse this particular phase-difference with that pointed out by Mr. Conrady, the latter being an entirely different and additional effect.

We now come to the photographs.

Fig. 6 shows the image of a reciprocal grating (magnification × 13), photographed in the ordinary manner. In the upper half, the width of the slits to that of the bars is as 1 to 2. In the lower half, the width of the slits to that of the bars is as 2 to 1. It will be seen that a bright line in the upper half always corresponds in position with a dark one in the lower half, and *vice versâ*.

Fig. 7 is the central part of the diffraction pattern produced by the grating in the back focal plane of the objective (monochromatic light having been used). It shows the central or zero maximum and the first and second maxima on both sides.

Fig. 8 illustrates diagrammatically the intensity curves produced by the upper half and those of the lower half of the grating, the dotted lines showing the intensity curve of a single slit in the upper half and in the lower half. It will be seen that, though the positions of the maxima in both cases coincide, the intensity curves of the single slits are different—that of the slit in the upper half being twice as wide as that of the slit in the lower half, because the former slit is half as wide as the latter. It will further be noticed that, owing to this fact, whilst the first maxima furnished by the two gratings both occupy a position between A and B on the

* See R. T. Glazebrook, "Note on the Diffraction Theory of the Microscope, as applied to the case when the Object is in Motion," Journal Physical Society of London, 1904, pp. 157–9. Also J. D. Everett, "A Direct Proof of Abbe's Theorems on Microscopic Resolutions of Gratings," this Journal, 1904, pp. 385–7. And also J. Rheinberg, "On the Influence on Images of Gratings of Phase-Differences amongst their Spectra," this Journal, 1904, pp. 388–90.

central band, the second maximum occupies a position between A and B only in the case of the upper grating; in the case of the lower grating it occupies a position on the first band, indicated by the dotted intensity curve of the single slit.

Fig. 9 is a photograph of the grating, all spectra being excluded from taking part in the image except those underlined *a* in fig. 7, viz. the zero and the first maximum on the right-hand side.

Observe that the relative position of the upper and lower set of lines remains unchanged, which indicates that, so far as these two maxima are concerned, there is merely the normal phase-difference, both as regards the upper and the lower half of the grating.

Fig. 10 shows a photograph of the grating, all spectra being excluded from taking part in the image except the underlined portion *b* in fig. 7, viz. the first and second maxima on the right-hand side.

Observe that the lines of the lower set have got shifted, so that the black and white lines run right through from top to bottom. This is because the spectra furnished by the upper half have merely the normal phase-difference, whatever that may be, whilst those furnished by the lower half have an additional difference of half a phase-period. On referring to fig. 8, it will be seen that this is explained by the fact that in the case of the lower grating the second maximum occupies a position on the first band which a single one of its slits would have formed, and, as we learnt above, a change of phase occurs at B.

Fig. 11 shows a photograph of the grating, all the spectra being excluded except the underlined part *c* in fig. 7, which comprises the first and second maxima and a small part of the zero maximum.

Observe that this photograph shows the transition stage from fig. 9 to fig. 10.

As regards the lower half, the combined influence is seen of the zero and first maximum being normal as regards phase-difference, together with the influence produced by the first and second, and by the zero and second maxima, having an extra difference of half a phase-period.

As regards all the spectra furnished by the upper half of the grating, everything is normal.

The effect shown in this photograph is only obtainable by adjusting the part of the zero maximum admitted very carefully, as the change in appearance from that in fig. 9 to that in fig. 10 is comparatively sudden. When a considerable part, or the whole, of the zero maximum is allowed to pass along with the first and second maxima, the effect is essentially as seen in photograph 9.

Mr. Conrady's experiment, here recorded photographically, constitutes, I think, striking evidence of the influence on the images of gratings of the phase-differences amongst their spectra, due to the relative width of the slits to the bars—a new point in the theory of the Microscope image of considerable importance.

OBITUARY.

Ernst Abbe.

Born, Jan. 23, 1840; Died, Jan. 14, 1905.

Ernst Abbe—the illustrious Honorary Member of our Society, to whom, more than to any other man, the perfection of the modern Microscope is due—was the son of a foreman in a spinning mill at Eisenach, in the Grand Duchy of Saxe-Weimar. Evincing talent at an early age, he was sent to the universities of Jena and Göttingen, at the latter of which he took his degree, his thesis being on the "Mechanical Equivalent of Heat." After passing a short time at Frankfort-on-the-Main as a Privatdocent,* he was, at the age of twenty-three, appointed by the Jena University as Lecturer on Mathematics, Physics and Astronomy, on the strength of a treatise on the "Theory of Errors." Three years later he was approached by Carl Zeiss, and induced to enter his firm as scientific adviser. Thus began one of the most fruitful periods of progress in the annals of optics. Carl Zeiss was a philosophical instrument maker of Jena, whose business in those days was of but very modest proportions. Imbued, however, with the necessity of placing the construction of optical instruments, and especially of Microscopes, on a more scientific basis, he looked around him for suitable help. Experts on the subject being unavailable, he had to find some one possessed of the necessary qualifications to become one, and with the necessary force of character to prosecute his work in the face of difficulties. That great obstacles would have to be surmounted Carl Zeiss appears to have been fully aware, especially as his first attempt to secure scientific guidance in putting Microscope construction on a proper theoretical basis had been a failure, and had led to his competitors recommending their Microscopes by saying, "They were *not* like those made at Jena." In his second choice of a coadjutor he was more fortunate, for Ernst Abbe proved himself eminently qualified for the work. Not more than two years had elapsed when, in 1868, at the age of twenty-eight, Abbe introduced his method of Microscope construction, consisting in the complete theoretical determination beforehand of the required data. Thenceforth the old haphazard trial-and-error methods of making objectives were completely discarded.

* A Privatdocent, for which we have no exact equivalent, is a university lecturer qualifying for a professorship.

Abbe had arrived at his results by studying afresh, from first principles, the whole problem of microscopic images, from the standpoints of both geometrical and physical optics. He came to the task with a fresh mind, for till that time he had not specialised in optics, nor had he worked much with optical instruments. This, in the case of an intellect so keen and vigorous, and fortified by the necessary training in physics and mathematics, was a positive advantage, for no preconceived ideas hampered him in drawing his conclusions from the extensive course of experimental work which accompanied his theoretical investigations. It was in the course of these that, following up the work of Fraunhofer on the telescope, he evolved his famous Theory of Microscopic Vision, based on his discovery of the modifications produced in the image by the diffractive action of the object itself on the light by which it is illuminated. This theory has been known chiefly under the name of the Diffraction Theory—presumably because in Abbe's original papers, to use his own words, "Different structures always yield the same microscopic images as soon as the difference of diffraction effect connected with them is artificially removed from the action of the Microscope; and that similar structures as constantly yield different images when the diffractive effect taking place in the Microscope is artificially rendered dissimilar."

Abbe showed that the optical system of the Microscope—usually considered as consisting of an objective to produce a magnified, inverted image, and an ocular acting as a simple magnifying glass to enlarge this image—might be analysed in a different way. He demonstrated that the Microscope system was equivalent to a telescope with a loup, or simple magnifying glass—to parallelise the rays from the object—placed in front of it. Thus, the Microscope objective can be looked upon as consisting of two lens components, one acting as a simple magnifying lens, behind which the other, acting as a telescope objective, occurs; the object and its image being in the principal focal planes respectively of these two components. In conformity with this characteristic analysis of the Microscope, Abbe treated the problems of microscopic image formation in two steps: firstly, investigating the nature of the light distribution in the back focal plane of the objective (which takes into account the diffractive action of the object on the light source, according to the mode of illumination); and, secondly, deducing the image in the image-plane from this. This method clearly brings out the difference between the imaging of self-luminous and non-self-luminous objects—a fact which has led to Abbe's theory being also known, more especially on the Continent, as the "Theory of Secondary Imaging."

The theory was first given to the world in 1873, in a paper entitled "A Contribution to the Theory of the Microscope and the Nature of Microscopic Vision," in M. Schultze's "Archiv für

Mikroskopische Anatomie." * This paper has been excellently translated into English by Dr. H. E. Fripp.†

Startling in the simplicity with which it admitted of experimental verification as to the resolving power of the Microscope,‡ and other problems imperfectly understood at the time, it created a considerable sensation. It also attracted to itself a good deal of criticism, which Abbe dealt with in 1880 in a controversial paper entitled, "On the Limitations of Geometrical Optics, with remarks on Dr. R. Altmann's paper on the 'Theory of Image Formation.'" §

About the same period there was a great controversy going on in this country on the "Aperture Question,"‖ and it is to Abbe that we owe the familiar term and significance of "Numerical Aperture." In a paper read before our Society, in 1877, he gave a description of his well-known Apertometer, for measuring the N.A. of objectives.

One of the direct results of Abbe's diffraction theory and his work on Numerical Aperture was the introduction of the Homogeneous Immersion System for microscopic objectives. Abbe, in a paper in 1879 before this Society,¶ tells how he had thought of realising this principle, but did not see the wide range of its usefulness till its complete advantages were pointed out to him by our late Fellow, Mr. John Ware Stephenson, who had discovered the principle independently.** He thereupon made the calculations for a series of objectives, which were executed by Carl Zeiss, and first introduced in 1878.

Two achievements of Abbe, in their direct and indirect results, influenced the history of the Microscope more than any others. They stand pre-eminent. The first, to which we have briefly re-

* Vol. ix. pp. 413–68.

† Proceedings of the Bristol Naturalists' Society, i. (1875) pp. 200–68. A very short but lucid abstract of this paper appears in our Journal (then the Monthly Microscopic Journal) xii. pp. 30–31, which is likewise of interest, as it is the first notice of the Abbe Illuminator (the two-lens form).

‡ This, and a number of other problems dealt with in Abbe's papers, had been investigated by Helmholtz at almost the same time. Though working on somewhat different lines, both investigators arrived at closely similar results. Helmholtz—who did not know of Abbe's work till his own paper, entitled "The Theoretical Limits of Optical Capacity of the Microscope," was ready for publication—acknowledges Abbe's priority in a postscript. Helmholtz's paper appeared in 1874, in the Jubelband of Poggendorff's Annalen, and has likewise been translated into English by Dr. H. E Fripp, Proc. Bristol. Nat. Soc., i. (1875) pp. 413–40.

§ Sitz. der Jen. Gesell. f. Med. und Naturwiss. (1880) pp. 71–109.

‖ For a concise historical review, showing the part played by Abbe and others, see paper by our ex-President, E. M. Nelson, on "Microscopic Vision," in the Proc. Brit. Nat. Soc., viii. (1897) part ii.

¶ "On Stephenson's System of Homogeneous Immersion for Microscope Objectives," ii. (1879) pp. 256–65.

** For previous anticipations of the Homogeneous Immersion System, see "Carpenter on the Microscope," 8th edition, p. 364.

ferred, was his Diffraction Theory. The second was the production of the Jena Optical Glass. Abbe had come to the conclusion that the main hindrance to further improvements lay in the paucity of the kinds of glass available. Already in 1874, in a paper dealing with measurements of dispersion and refraction,* he had drawn attention to the fact that "makers of optical glass denominated their products according to their specific weight, as though they were destined for ships' ballast," and had gone on to show how glasses having a different relation between the mean refractive index and dispersive power were absolutely a necessity. In 1876 he came over to this country to inspect the scientific apparatus at the International Exhibition; and a report which he wrote on the Loan Collection of Microscopical Apparatus at South Kensington † may be classed as one of the most important of his papers, for it was in this treatise that he set himself to explain in detail the need of producing suitable new kinds of glass, which had the effect of attracting Dr. Otto Schott, a Westphalian glass-maker, who volunteered to assist in the work.

Experimental work on a small scale was begun by Schott in 1881. In 1882 he removed to Jena. The results were so promising, that Abbe, by his efforts, was able to obtain a large grant from the Prussian ministry in aid of further work in the same direction, and in 1884 the manufacture was placed on a wholesale industrial footing. A year later the first fruits were seen, and Abbe had brought out Apochromatic Objectives and Compensating Eyepieces.

In a short memoir like this, a mere mention of some of the other apparatus devised by Abbe must suffice. Amongst these may be mentioned the Refractometer and Spectrometer bearing his name (1874), the Camera Lucida (1881), and the Microscope Illuminator (1872). The latter, curiously enough, was originally designed only for testing Microscope objectives. The Demonstration Microscope, in which his theoretical analysis of the Microscope is carried out into practice, should also not be forgotten. But, apart from the instruments bearing his name, his influence may be traced in the many productions of the firm of Carl Zeiss. The history and development of that undertaking, as well as of the Optical Glass Works, are indissolubly connected with Abbe, and are a striking testimony, not only to the achievements of Abbe the man of science, but also of Abbe the social reformer and the capable organiser and administrator. For, great as Abbe showed himself as a pioneer in the paths of science, he was equally great as a pioneer in other directions.

* Jenaische Zeitschr. f. Naturwiss., viii. (1874) pp. 96-174.

† "The Optical Means of Assisting Microscopy," published by A. W. Hofmann 1878.

Sprung from the working classes himself, and brought into contact with them from his youth, he keenly sympathised with them in their troubles. When, therefore, in 1888, a year after the death of Carl Zeiss, the latter's son, Roderich, retired from the firm, leaving Abbe, who had been a partner for thirteen years, as sole proprietor, he at once set about the realisation of his dreams of social reform. Abbe was a collectivist. Following the doctrines of Herbert Spencer, Abbe—the friend of Haeckel—looked upon an industrial establishment in the light of a living organism, dependent for its growth, development and the products of its activity not only on its individual members, but on their co-ordinated action as a whole. He, therefore, considered that a considerable part of the profits of an industrial establishment should go to the benefit of the members collectively. Pushing the analogy further, because an organism is dependent on its environment, and has been moulded by the continuous action of traceable causes, therefore these factors which contribute to its successful evolution should also receive a due measure of consideration. It is evident from certain of his speeches, notably a remarkable speech delivered in 1897 on profit-sharing in the Zeiss Optical Works, that some such considerations influenced him; and Abbe, who was a combination of the idealist, the man of action and the philanthropist, put his ideas into execution.

In 1891 he founded the Carl Zeiss "Stiftung," * ceding to the same all his rights, both in the Optical and in the Glass Works, and merely retaining a position as manager. The statutes state that the aim of the "Stiftung" is the consolidation and development of the industries, as carried on by the Optical and the Glass Works, in such a manner as to afford lasting security for providing a large number of people with the most favourable opportunity for labour, and securing to them collectively greater benefits than can be the case where personal proprietorship exists; and to assist in elevating their personal and social status.

In pursuance of these ideas, we find, after the regulations as to the payment of workers, provisions for securing that no worker can have his wages reduced, that no worker can be dismissed without compensation, that no one, not even a manager, can receive a salary more than ten times the average yearly earning of workers above twenty-four years old who have been three years in the firm. Then we find provisions as to sick funds, superannuation and pension funds, which extend also to the widows and orphans of employés. After the provisions for the reserve funds, and payment of a small share of the profits to all employés, according to

* A "Stiftung" is an institution founded as the result of a bequest, and has to be administered under certain statutes. The nearest English equivalent is the word, "Trust," which, however, in certain respects conveys a different sense.

their wages, if the profits realised permit of this, it is provided that a considerable portion of same be set aside for more general interests. In the first place come grants for public institutions, etc., for the benefit of Jena and district. Secondly, grants in aid of research and teaching in the science of optics, which may take any shape or form. Thirdly, grants in aid of pure scientific study or research in the whole domain of science, and without reference to any benefit it may confer on the "Stiftung."

With what success Abbe has achieved his ideals is seen from the mere fact that the "Stiftung" has already built a people's institute, with a large public library, at a cost of 50,000*l.*, and has also subsidised the Jena University to the extent of close on 100,000*l.*

Abbe had close relations with our Society, in which he took a great interest, as is evinced by the fact that of the twenty-two papers on the theory of the Microscope, which are published in the first volume of his collected papers,* no less than nine are communications to this Society. A complete list of them is appended. On 1st May, 1878, he was elected as an Honorary Fellow, and in 1879, when he came over to this country, he gave a demonstration on his "Theory of the Microscope and the Nature of Microscopic Vision" at one of our Meetings. A further series of his writings on the Microscope, based on, as yet, unpublished material, may, we are led to hope from Dr. Czapski's preface to Abbe's collected papers, be forthcoming in another volume of these, and will certainly be looked forward to with much interest. For, in the stress of continuous productive work, Abbe, unfortunately, never found time to write for publication an exhaustive treatise on his "Theory of the Microscope," or much of his other work, and it has to be gathered out of various publications. With reference to the Microscope, his collected papers to a great extent supply the want,† and Czapski's "Outlines of the Theory of Optical Instruments after Abbe,"‡ as well of a recently published work on "Image Formation in Optical Instruments from the Standpoint of Geometrical Optics," § by the scientific collaborators of the Zeiss Works, give much information on a great deal of Abbe's other optical work and theories. The

* "Gesammelte Abhandlungen von Ernst Abbe," by the scientific collaborators of the Zeiss Optical Works, edited by Dr. S. Czapski, published 1904, Gustav Fischer, Jena.

† In chapter iii. of "Carpenter on the Microscope," edited by Dallinger, 8th edition, 1901, will be found an excellent condensed account of the Abbe Theory, with references also to certain modifications of Abbe's views. These latter must have occurred about the year 1880. The best connected and condensed account of the Abbe Theory in German will be found in Dippel's "Handbook of Microscopy," 2nd edition, 1882, chap. iii.

‡ This work forms a part of Winkelmann's "Handbuch der Physik," but is published separately. Second edition, 1904, published by Barth, Leipsic.

§ Edited by M. von Rohr. Published 1904, Julius Springer, Berlin.

best general and popular account of Abbe's life and work is to be found in Professor Auerbach's little book on the Carl Zeiss "Stiftung," of which an English translation has just appeared.*

Abbe was a member of many learned societies. Amongst other distinctions, he was appointed Extra-Ordinary Professor of the University of Jena in 1870, and had the honorary degree of Doctor of Medicine conferred on him by the University of Halle, and Doctor of Laws by the University of Jena. He married, in 1871, a daughter of his former teacher, Professor Snell, and had two daughters. He always lived in the simplest style, and his unassuming manners, his accessibility to the humblest of his work-people, his unvarying kindness, the knowledge of his strong sense of fairness and justice, and his noble ideals, led to his being universally esteemed, and in many cases revered. He was one of those magnetic personalities who seemed to be able to influence all those around. Though he had plenty of opponents of his sociological, as well as of his scientific ideas, he had no enemies; for everyone knew that everything he did or said was actuated by the single-minded desire for reform and progress, and no one was more unmindful of self. He ever kept his name in the background, and in all he did sought to bury his own individuality. Expressions of thanks or admiration for anything he did were waived aside. The fact of having moved in the direction of his ideals was sufficient for him. To realise those ideals, to carry out some improvement in science, to elaborate some plan for the betterment of his employés, he would work day in day out, allowing himself no relaxation, and in the end, indeed, he completely shattered his constitution thereby.

It is rare to find a high degree of idealism combined with persistent and consistent action to the attainment of its end. To the combination of qualities, seldom found together in one individual, we must look in a great measure for the cause of Abbe's greatness. Not alone the acuteness of his intellect, whether applied to scientific research or to sociological problems, made Abbe what he was; neither was it his lofty aspirations, his philanthropy, nor his undoubted talent as an organiser—it was the union of all these with the will-power, the energy and determination to carry through everything that he conceived to be right, regardless of obstacles and of the complete self-abnegation it entailed, that led to the remarkable achievements which have secured for Abbe a fame that time will not impair.

* "The Zeiss Works and the Carl Zeiss 'Stiftung,'" by Felix Auerbach, translated by Paul and Cheshire. Published 1904, by Marshall, Brookes and Chalkley, Limited, London.

List of Papers and other Communications made to The Royal Microscopical Society by Professor E. Abbe.

On Stephenson's System of Homogeneous Immersion for Microscope Objectives.—1879, p. 256.

On New Methods for Improving Spherical Correction, applied to the Construction of Wide-Angled Object-glasses.—1879, p. 812.

Some Remarks on the Apertometer.—1880, p. 20.

On the Conditions of Orthoscopic and Pseudoscopic Effects in the Binocular Microscope.—1881, p. 203.

Note on a Fluid for Homogeneous Immersion.—1881, p. 366.

On the Estimation of Aperture in the Microscope.—1881, p. 388.

The Relation of Aperture and Power in the Microscope:—

I. General Considerations as to Wide and Narrow Apertures.—1882, p. 300.

II. The Rational Balance of Aperture and Power.—1882, p. 460.

II. Continued. (ii.) Division of the entire Power of the Microscope between Ocular and Objective.—1883, p. 790.

On the Mode of Vision with Objectives of Wide Aperture.—1884, p. 20.

Note on the Proper Definition of the Amplifying Power of a Lens or a Lens-System.—1884, p. 348.

Note on Limits of Resolution in the Microscope.—1885, p. 970.

On Improvements of the Microscope with the aid of new kinds of Optical Glass.—1887, p. 20.

On the Effect of Illumination by means of Wide-Angled Cones of Light.—1889, p. 721.

[Some of the papers were written in English by the author, others were in German, and were translated.]

Julius Rheinberg.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Evolution Theory.‡—August Weismann's lectures on the evolution theory have been translated from the second German edition (1904), and supply what may be called a general text-book of organic evolution. They represent the fruit of a life-time of observation and reflection, a veteran's judicial summing up of his results, and certainly one of the most important contributions to evolution literature since Darwin's day.

As the author's preface indicates, the salient features of his crowning work are: (1) the illumination of the evolution process with a wealth of fresh illustrations; (2) the vindication of the "germ-plasm" concept as a valuable working hypothesis; (3) the final abandonment of any assumption of transmissible acquired characters; (4) a further analysis of the nature and origin of variations; and (5), above all, an extension of the selection principle of Darwin and Wallace to its logical outcome in the suggestive theory of germinal selection.

Maturation and Fertilisation in the Axolotl.§—J. W. Jenkinson gives a detailed account of these processes. His results, in the main, corroborate the work of previous writers, although, with reference to the origin of the cleavage centrosomes, he brings forward an account which differs from that of Fick. This writer held that these bodies arose from the sperm middle piece, while the present author states there is a stage

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This Section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ The Evolution Theory, by August Weismann, trans. by J. Arthur Thomson and Margaret R. Thomson, i., xvi. and 416 pp., 95 figs. and 3 coloured plates; ii., 405 pp., 46 figs. London (Arnold), 1904.

§ Quart. Journ. Micr. Sci., xlviii. (1904) pp. 407–82 (5 pls.).

where the middle piece disappears. He adduces evidence of the formation of the definitive centrosome *de novo* from the sperm nucleus. The paper includes a critique of current theories of fertilisation, and also an account of experiments designed to throw light on the nature of the physical processes involved in these phenomena.

Dermoid Cysts of Ovary and Testis.*—S. G. Shattock discusses the origin and significance of these growths; describing in particular a remarkable specimen from a human subject which contained two ill-formed lower limbs between which there was a vulva, and behind the latter a median perineal raphé. Above the vulva there grew a tuft of long pubic hair, whilst the rest of the teratoma was covered with lanugo only. At the base of the mass was a smooth cavity in which there lay a blind coil of intestine. In each of the lower limbs there was an elongated compound skeletal element, and in the trunk a rudimentary spinal column and pelvic girdle. On one side there was a rudimentary upper limb. Medullated nerve tissue was demonstrated in the spinal cord. The author reviews and rejects the hitherto proposed theories of such cysts, substituting one which he terms "epigenesis." He suggests that the ovarian teratomatous cyst resulted from the fertilisation of a primordial ovum in the embryo, so that the embryo furnished a second imperfect individual, the origin of which was not therefore synchronous with, but later than itself. It is not necessary to suppose that a second penetration of the developing ovum by spermatozoa took place. It is well-known that more than a single spermatozoon may perforate the investing membrane of the ovum, and one might fertilise a primordial ovum, which is assumed to be early formed. This theory involves the preliminary maturation of the ovum at an abnormally early date. Further, in the case of such cysts in the testicle, the assumption has to be made that the gonad in question contained primordial ova—was, in fact, an ovo-testis.

Secretions of the Genital Organs.†—G. Loisel, in a second paper, continues his account of the phenomena of secretion of the genital organs. The present paper deals with the absorption of unlaid ova (spurious corpora lutea), the function of the interstitial cells, the chemical products elaborated in the ovary, and the toxic qualities of the ovary compared with that of other tissues. In general, it may be stated that the ovary fulfils a purifying function in the organism. This consists in fixing, transforming, or destroying certain injurious products poured into the blood by the somatic tissues and brought to the ovary by the arterial system. The elements which treat these products are, in invertebrates, the ova and follicular cells; in vertebrates, the corpus luteum and interstitial cells. Some of the products are purely and simply excreted, others are thrown out along with the ova and utilised in sexual reproduction, while others are reabsorbed by the organism as internal secretions.

Absorption of Yolk in Viper Embryos.‡—H. Dubuisson has en-

* Brit. Med. Journ., No. 2288 (1904) pp. 1248–9.
† Journ. de l'Anat. et Phys., xli. (1905) pp. 58–93.
‡ Comptes Rendus, cxxxix. (1904) pp. 684–6.

deavoured, by means of sections in different planes through the yolk sac, to gain some knowledge on this subject. For example, he finds in a section perpendicular to the long axis of an embryo of 5 mm., and through the umbilical vein, that the perivitelline cells are transformed into digestive tube cells. In cells with superficial yolk spherules fusion of these is seen, and, from these, cells with vacuolated contents result. The contents gradually become basophile, the inter-vacuolar spaces diminish in thickness, and cells with a protoplasmic reticulum surrounded by vacuoles form the next stage. These cells are still in relation to a homogeneous vitellus. Lastly, the cells of the digestive tube possess a closely reticulated basophile protoplasm.

Comparative Anatomy of the Placenta.*—Hans Strahl communicates an important paper on the placenta in lemurs (*Galago*, *Propithecus*, *Lemur*), in *Viverra civetta* and in *Centetes ecaudatus*. The lemurs have a *semiplacenta diffusa*; the civet, a *placenta zonaria simplex*: and *Centetes*, a *placenta discoidalis perforata*, along with an annular *semiplacenta avillosa*.

Placenta of Seal.†—A. J. P. van den Broek gives an account of the fœtal membranes and the placenta of *Phoca vitulina*, which have not been previously described in detail. He makes an interesting comparison between the conditions in the seal and those in dog and other fissipeds, showing that the pinnipeds are as distinct in placental relations as otherwise.

Involution of Uterine Mucous Membrane in Tarsius.‡—Hans Strahl describes the processes of involution gone through by the uterus of *Tarsius spectrum* during the puerperal period. These take their own peculiar course, and are unlike those which occur in any of the other mammals in which the history of the uterus has been carefully studied.

Implantation of Ovum of Spermophilus.§—J. Rejsek describes the early syncytium, formed by some of the cells of Rauber's layer, which effects the fixation and primary nutrition of the ovum of *Spermophilus citillus*. The processes of the syncytium bring the ovum into close connection with a fluid material, which is mainly due to maternal cell-products (derivatives of the blood, plasma and serum). The implantation and primary nutrition are altogether apart from the subsequent placentation.

Spermatozoa of Discoglossus Pictus.‖—E. Ballowitz gives a description of the remarkable spermatozoa of this amphibian, which measure 2¼ mm. in length.

Significance of the Nucleolus in the Maturing Ovum.¶—Konrad Guenther has studied this problem in sea-urchins and holothurians. He finds that the nucleolus is a drop secreted from the nuclear framework.

* Abh. Senckenberg Nat. Ges., xxvii. (1904) pp. 263–319 (10 pls. and 1 fig.).
† K. Akad. Wetenschappen Amsterdam (Proc. Sect. Sci.) vi. (1904) pp. 610–9.
‡ Op. cit., vi. (1903) pp. 302–5.
§ Arch. Mikr. Anat., lxiii. (1903) pp. 259–73 (1 pl.).
‖ Tom. cit., pp. 343–64 (1 pl.).
¶ Zool. Jahrb., xix. (1903) pp. 1–28 (1 pl.).

into which the chromatin penetrates, segregating itself and arranging itself prior to division. In the nucleolar fluid there may be at the same time an intense metabolism.

Determination of Sex.*—Heinrich Bayer discusses fertilisation and sex determination from a gynæcologist's point of view. As to fertilisation, he agrees in the main with Boveri and de Vries. As to sex-determination, he argues against the position of O. Schultze and Lenhossek, that the sex is predetermined *in ovo*, and inclines to attach importance to the spermatozoon as well. In particular, he maintains that the energy of the sperm-centrosome is determinative. When its energy is great, the offspring tends to be female, when its energy is less, the offspring tends to be male.

Cytasters and Centrosomes in Artificial Parthenogenesis.†—E. B. Wilson found that centrosomes may arise by new formation in the artificially induced parthenogenesis of sea-urchin ova. This result has been vigorously criticised by Petrunkewitsch. Wilson answers the criticisms of Petrunkewitsch, which do not seem to him to overthrow, or even weaken, the case for the independent new formation of centrosomes.

"I willingly grant that a phenomenon so surprising, and of such far-reaching significance, as the new formation of centrosomes, capable of division, in a non-nucleated mass of protoplasm—or the hardly less remarkable one of a multiple free-formation in an entire egg of centrosomes capable of subsequent division—is not to be unreservedly accepted without additional study of the most careful kind, and by different observers; but if my conclusions on these points are to be rejected, it must be on evidence more adequate than that brought forward by Petrunkewitsch."

Development of the Venous System in the Mole.‡—A. Soulié and C. Bonne give a detailed account of the constitution and successive modifications which the venous system presents during fœtal life. A very complete series of embryos, from 1·6 mm. to 20 mm. long, has been utilised as a basis for their conclusions, which, in a synthetic and comparative manner, they give of the evolution of the venous system in the mole during both the first and second circulations.

Development of Olfactory Organ in Spinax Niger.§—O. Sund has examined a series of embryos of *S. niger* up to 4 cm. He describes a paired blind sac in the anterior region of the olfactory organ, which in origin, development and innervation is strikingly similar to Jacobson's organ, and with which the author suggests the latter is probably homologous.

Development of Gills of Fishes.‖—T. Moroff finds that the mode of origin of the gill-slits in the different groups is as follows. In Cyclostomes there are evaginations from the gut, which, on reaching the

* Befruchtung und Geschlechtsbildung Strassburg (1904) pp. 39. See Zool Zentralbl., xi. (1904) p. 779.
† Zool. Anzeig., xxviii. (1904) pp. 8–12.
‡ Journ. de l'Anat. et Phys., xli. (1905) pp. 1–39 (3 pls.).
§ Biol. Centralbl., xxiv. (1904) pp. 651–9.
‖ Arch. Mikr. Anat., lxiv. (1904) pp. 189–213 (2 pls.).

ectoderm, fuse with it, and thus the gill-slits originate. Obviously they are endodermal, and in the further development of the gill apparatus there is no change in this. In Teleosteans and Ganoids a reverse process takes place; there are ectodermal ingrowths, with very slight outgrowths from the gut. Ultimately ectoderm reaches the gut wall in all the slits, and thus the presence of skin teeth on the inner edges of the arches and in the gullet is accounted for. In Selachians an intermediate condition exists, there being gut folds which blend with slight invaginations of ectoderm. The largest part is thus endodermal at first, but later the conditions are reversed. The endodermal part of the pockets disappears completely, and in mature animals the inner openings alone of the slits are lined by it, and thus a similar condition to that in Teleosteans is reached. The development of the gill apparatus is also considered in the paper.

Development of Kidney in Elasmobranchs.*—I. Borcea has studied this in *Mustelus* and *Acanthias*, and finds that the Elasmobranch kidney is embryologically of the same value as that of higher vertebrates.

Development of Myocardium in Teleosts.†—J. Boeke finds that in Muraenoid larvae the myocardium forms a syncytium, as others have observed in mammals. During the differentiation of the fibrils, the cell limits, at first distinct, are lost, and the cells fuse into a syncytium. The author indicates the importance of this fact in relation to the physiology of the heart muscle-fibres.

b. Histology.

Intra- and Extra-Cellular Nerve Nets in Vertebrates.‡—L. Auerbach gives proof for his view, brought forward in the paper, that the end branches of the axis cylinder do not remain separate from each other, but, contrary to the usual idea, blend in a peculiarly continuous network.

Peripheral Nerves of Vertebrates.§—R. G. Harrison finds that the axis cylinders of motor nerves are developed in a normal manner in frog embryos, in which the occurrence of Schwann cells has been prevented by the early cutting out of the "Ganglienleiste." The nerves are here naked fibres, which can be followed as such into the ventral part of the tail musculature. The sensory nerves of the tail consist in Triton larvae, first of naked branched fibres, which from their origin in the hinder cells and the spinal ganglia to their termination show no Schwann cells. These cells only appear after the fibre is formed; they come forward gradually from the centre to the periphery, as may be seen by a comparison of different stages, and by direct observation on the fins of living tadpoles. The Rohon-Beard hinder cells of the frog embryo early throw out protoplasmic continuations, which stretch under the skin and become nerve fibres. The end of the developing nerve fibre consists of a thickening with delicately branched pseudopodic ter-

* Comptes Rendus, cxxxix. (1904) pp. 747–9.
† K. Akad. Wetenschappen Amsterdam (Proc. Sect. Sci.) vi. (1903) pp. 218–25 (1 pl.).
‡ Anat. Anzeig., xxv. (1904) pp. 47–55.
§ S.B. Niederrhein Ges. Nat. Bonn. (1904) pp. 1–7.

minations. These fibres are first simple, later they divide, and finally the branchings of neighbouring cells interlace to form a plexus. No Schwann cells, from begining to end, are present in these cells. It is consequently certain that the nerve fibres arise simply from the ganglion cells, and it is quite inadmissible that the Schwann cells have to do with the genesis of the axis cylinder or with the peripheral end-branchings of the same.

Cornu Ammonis in Man.*—R. Wiedershiem records having observed, in certain old and badly preserved preparations of the human brain, appearances resembling interlocking teeth, in the cornu ammonis, such as Jung had previously described as a "Zackenlager." The author considers this layer a secondary formation in old specimens, and not a normal structure.

Olfactory Buds in Vertebrates.†—K. Kamon has made a comparative histological examination of the olfactory and taste buds in *Esox* and *Trigla*. He finds numerous differences between these two sets of organs, and considers, in consequence, that Blane's theory of homology is at fault. The epithelial buds, described by Disse, in the olfactory region of mammals, particularly in the calf, are not present in these fishes. These buds are simply concentric groupings of olfactory epithelium around invaginations towards the tunica propria. There are neither in the olfactory mucous membrane of fishes nor of mammals comparable formations.

Structure of Hypophysis in Vertebrates.‡—G. Sterzi has investigated this in representative types from Cyclostomes to Mammals. The hypophysis is always formed of two parts—a nervous *processus infundibuli* and an epithelial *saccus vasculosus*, but there is great variety in the relative development of these two parts and in their details. The epithelial portion is always composed of two distinct areas, distinguished histologically, e.g. by their staining reactions, as "chromophilous" and "chromophobic."

Fibrillar Structure in Frog's Liver.§—Max Wolff describes remarkable fibrillar structures in the frog's liver, which are not nervous, as Allegra maintained, but connective in nature, and are in close association with the capillary network. The paper includes a discussion of the differential diagnosis of nervous and non-nervous fibrillar elements.

Adipogenic Function of the Mammalian Liver.‖—C. Deflandre finds that this function, as proved by chemical analysis, is normal in mammals. It is notably augmented during gestation and lactation. The products appear to be absorbed by the fœtus from the maternal liver, and accumulated provisionally. Further, in certain food conditions, e.g. after a meal rich in fat, or by transformation into fat of other elements, and in pathological states of fatty degeneration, the adipo-hepatic function is increased.

* Anat. Anzeig., xxv. (1904) pp. 113–18.
† Arch. Micr. Anat., lxiv. (1904) pp. 653–63 (1 pl.).
‡ Atti Accad. Sci. Veneto-Trentino-Istriana, New Series, i. (1904) pp. 70–141 (9 figs.).
§ Anat. Anzeig., xxvi. (1905) pp. 135–44 (4 figs.).
‖ Journ. de l'Anat. et Phys., xli. (1905) pp. 94–101.

Epithelium of Stomach.*—M. C. Dekhuyzen and P. Vermaat have studied the epithelium lining the stomach in rats, mice and rabbits. Some of the cells have the power of sending out a large number of cell-filaments, which stand closely together when the striated border is contracted and when the filaments have their minimum length, but which can also be extended, and are then enabled to diverge. The "outer limbs" vary greatly in appearance, now more hair-like, and again less delicate. Like similar cells in the intestine, they are apparently absorptive, for some showed small drops of fat.

Peculiar Osseous Tissue of Sunfish.†—Felice Supino describes afresh the peculiar bony tissue of *Orthagoriscus*, which is so soft that it can be readily cut with a razor. It is quite distinct from cartilage, and exhibits a sort of network, in the meshes of which there is an amorphous hyaline substance, not readily stainable (non-calcified ossein according to Harting), including a few cells and numerous long and tortuous fibres.

Minute Structure of the Suprarenals in Guinea-Pig.‡ — Franz Fuhrmann distinguishes sharply between the external cortical layer (zona glomerulosa and part of the zona fascicularis of Arnold) and the internal cortical layer (zona reticularis) of Arnold. The medullary area consists of internal cortical cells in a different functional state. The detailed characters of the elements of the external and internal layers are described at length.

Eyelids of Mammals.§—H. Eggeling has made a comparative study of mammalian eyelids, which are primarily folds of the integument clothed externally and internally with many-layered flat epithelium, hairs, and skin-glands. Internally, the integumentary characters are mostly lost, but the many-layered flat epithelium may have considerable development, and meibomian glands arise from sebaceous glands near the margin. The so-called tarsus, a firm differentiation of the connective tissue, within which the meibomian glands lie, is characteristic of quadrumana. Much of the increased differentiation in mammals, as compared with other vertebrates, is due to the increased development of the eye musculature.

c. General.

Formation of a Species.‖—J. F. Walker discusses what takes place when one species is changed into another. When the species A is converted into the species B, there must be an intermediate transitional stage, in which the collection of individuals is neither the species A nor the species B. A species is defined as a centre round which individuals are thickly clustered, and the spaces between these centres may be either devoid of individuals or contain here and there an abnormal form. The true type of a species is its centre, where the individuals are most thickly clustered and most closely resemble each other; those further from the

* K. Akad. Wetenschappen Amsterdam (Proc. Sect. Sci.) vi. (1903) pp. 30–4.
† Atti. R. Accad. Lincei (Rend.) xiii. (1904) pp. 118–21.
‡ Zeitschr. f. wiss. Zool., lxxviii. (1905) pp. 522–60 (2 pls.).
§ Jenaische Zeitschr. f. Naturwiss., xxxix. (1904) pp. 1–42 (18 figs.).
‖ Geol. Mag., Decade V., ii. (1905) pp. 15–17.

centre differ less or more widely from the type as they approach nearer the boundary of the species. As a species moves, either in geographical space or geological time, the position of its centre will gradually alter, if its environment be different, so that forms like those contained near the boundary of the species A, and therefore not typical of it, may become the centre of the species B and typical of it. These sentences give a general indication of the author's point of view.

Theory of Sleep.*—A. Gorter begins by discussing the different well-known theories as to the cause of normal sleep. Sleep has been referred to "anæmia of the brain," to interruption of contact between the neura, to accumulation of fatigue-substances, and so on. Gorter thinks that normal sleep is due to cessation or decrease of stimuli from the surroundings, and that it has been phylogenetically evolved in direct relation to the sun. Man's need for sleep is an inheritance from the animal world, and may be greatly lessened. In coming generations sleep may perhaps be dispensed with, but the individual life will be shortened.

Nutritive Arteries of Long Bones.†—P. Piollet finds that in human embryos the principal feeding arteries of the long bones of the limbs are either perpendicular, or inclined towards the distal extremity of the limb, i.e. in the direction of the blood current. As growth goes on, by the fact of unequal growth at the two extremities of the bone, the place of entrance of an artery into the bone is carried away from the epiphysis which furnishes most of the bone. The result is, the feeding artery takes an oblique course and is directed to the extremity of the bone which is growing least. In consequence of growth in thickness, by the juxtaposition of osseous layers of periosteal origin, the nutritive canal also takes the same obliquity. In adults the feeding arteries and the canals containing them are directed as follows: For humerus, radius and ulna, towards the elbow; for femur, tibia and fibula, from the knee; for metacarpals and metatarsals, towards the extremity without uniting cartilage. Briefly, the nutritive arteries of the long bones of the adult are directed away from the more active epiphyses, the mechanical result of the unequal elongation of the two extremities of the bone.

Multiple Origin of Horses and Ponies.‡—J. Cossar Ewart points out that in post-glacial as in pre-glacial times there were several distinct species of horses, and that it is extremely probable that some of the prehistoric species and varieties have persisted almost unaltered to the present day. He describes three distinct kinds of living horses, viz. the wild horse of the Gobi desert (*Equus caballus prjevalskii*); the Celtic pony, which, though no longer wild, may be known as *Equus caballus celticus*; and the Norse horse, which may very well stand as the type of the large occidental breeds and be known as *Equus caballus typicus*.

In addition to these three very distinct types—two at least of which have taken part in forming quite a number of our British breeds—we

* K. Akad. Wetenschappen Amsterdam (Proc. Sect. Sci.) vi. (1903) pp. 86–91.
† Journ. de l'Anat. Phys., xli. (1905) pp. 40–57.
‡ From Trans. Highland and Agric. Soc. Scotland (1904) 39 pp. (25 figs.).

have a long-headed, heavily built variety with a straight profile, and a long-headed heavily built variety with a more or less pronounced Roman nose.

In addition to several occidental varieties, there are several African and oriental varieties; and, in as far as the English thoroughbred is a mixture of African and oriental varieties and of occidental light and heavy varieties, it might be cited as an excellent example of a breed which includes amongst its ancestors several wild species—a breed which has had a multiple origin.

Phylogeny of Mammalian Tongue.*—J. Tokarski has made some observations on the comparative anatomy of the tongue in *Nasua socialis*, *Phascologale flavipes*, *Halmaturus ualabatus*, *Felis catus*, etc. As a result of his inquiries he concludes that the muscular tongue, together with a part of its supporting organ, has been separated off in its whole length from the lower tongue. This was necessitated as muscular elements became more numerous, on account of the hindrance to free movement caused by the processus ento-glossus. Before this took place there was formed, from the original perichondrium of the processus, a perpendicular wall of division, which formed a support for the transverse musculature, the septum linguæ. In many cases this represents a direct continuation of the lyssa capsule. Oppel's statement that the lyssa must be considered in many animals as a neomorph, on account of the absence of rudimentary tissues, is probably incorrect.

Anatomy of Notoryctes Typhlops.†—G. Sweet discusses the anatomy of the organ of Jacobson and associated parts, claiming that they afford evidence of a close affinity of this Polyprotodont with the Diprotodonts by way of *Æpyprymnus* and *Petaurus*, and also, though at a much greater distance, with the Edentates and Rodents. Corroborative evidence is afforded by the iliac arteries.

Copulatory Organs in Mammals.‡—Ulrich Gerhardt has made a comparative study of the mammalian penis, and shows its remarkable specialisation in various types, which is apparently correlated with the effective discharge of its function in the coitus.

British Mammals.§—J. G. Millais has completed Volume I. of a magnificent work on British Mammals, which includes a wealth of beautiful illustration and a full account of habits and distribution. It is the work of one who is fortunate in combining the qualities of artist and naturalist. The first volume relates to the Chiroptera, Insectivora, and Carnivora (exclusive of Mustelidæ).

Catalogue of Canadian Birds.‖—John Macoun completes his catalogue, which brings together all the available knowledge of the distribution and the breeding habits of Canadian birds. The third part

* Anat. Anzeig., xxv. (1904) pp. 121–31.
† Proc. Roy. Soc. Victoria, xvii. (1904) pp. 76–111 (4 pls.).
‡ Jenaische Zeitschr. f. Naturwiss., xxxix. (1904) pp. 43–118 (1 pl.).
§ The Mammals of Great Britain and Ireland. By J. G. Millais. Vol. I., pp. xx. and 363; illustrated. London (1904).
‖ Geol. Survey of Canada (1904) pp. 415–733, and xxiii. pp. of Index.

deals with sparrows, swallows, vireos, warblers, wrens, titmice, and thrushes.

Jaw-Muscles of Snakes in Relation to the Poison-Gland.*— Nils Rosén gives an account of *M. masseter* and *M. temporalis* in various snakes. He finds that *M. masseter* (M. par.-quadr.-mandib.), and especially the first portion of it, has an important role in compressing the poison-gland. He does not deny a minor role to other muscles, and to the tension of the *ligamentum zygomaticum*.

Locomotion of Snakes.†—P. Buffa has made a detailed study of the musculature of the skin, and gives the particulars in each of twenty-three species. As a result, he concludes that crawling in serpents is the result of the very complex relations of two different categories of movement. These are movements of the scales, the whole integument and the ribs, which last are controlled by the special connections existing between the scales and integument. The second set of movements are those instituted by the muscles uniting the scales themselves, and uniting scales and ribs. The ribs act as a fulcrum to the body, in which function the undulatory movements of the body as a whole undoubtedly take part.

Effect of Heat on Colour-Changes of Anolis Carolinensis.‡— G. H. Parker and S. A. Starratt find that the temperature is a factor in the colour-change of this lizard. At 10° C. the animal becomes brown, and remains so irrespective of illumination (115 candle-metres). At this temperature heat is the controlling factor. At 40° and 45° C., the lizard becomes green or greenish-grey, and remains so irrespective of illumination (115 candle-metres). Here again heat is the controlling factor. At intermediate temperatures, 20°–35°, light (115 candle-metres) and dark are controlling factors, but the effect of heat is still evident over this range in that it may influence the *rate* of the colour-changes.

Influence of Food on Length of Intestine in Tadpoles.§—Emile Yung has experimented with the larvæ of *Rana esculenta*, by giving them different kinds of food. Whatever the diet be, the intestine elongates rapidly until the hind limbs appear, then it diminishes until the development of the hind limbs is complete, after which it elongates slightly. From the time the fore limbs show themselves, the intestine shortens persistently.

The vegetarian larvæ always have a longer intestine than the carnivorous forms. The difference is most marked during the period before the appearance of the hind limbs. The fact that the shortening of the intestine, common to all larvæ, but most marked in the vegetarian forms, coincides with the periods of metamorphosis during which the larvæ eat little or nothing, lends support to the view that the length of the intestine is a function of the quantity of food which it contains.

* Zool. Anzeig., xxviii. (1904) pp. 1–7 (6 figs.).
† Atti Accad. Sci. Veneto-Trentino-Istriana, Anno I. (1905) pp. 145–237 (4 pls.).
‡ Proc. Amer. Acad., xl. (1904) pp. 457–66.
§ Comptes Rendus cxxxix. (1904) pp. 749–51.

Monstrosity of Bladder in Frog.*—W. Woodland reports a case in which the left lobe of the bladder of *Rana temporaria*, was proximally stretched to form a thin tube, which, running anteriorly in the body-cavity, perforated the muscular portion of the ventral body-wall, and expanded distally into a spherical sac, lying external to the muscles and in the median ventral lymph-sinus. Permanently imprisoned in the distal sac was a full-grown specimen of the usual parasite, *Polystomum integerrimum*.

Correlated Protective Devices in Salamanders.†—M. E. Hubbard has found in three species of salamander a relation between the power of autotomy and the presence of poison glands. They form a graduated series. *Batrachoseps attenuatus* yields comparatively little poisonous secretion when stimulated, *Plethodon oregonensis* yields it abundantly on the tail, and *Diemyctylus torosus* pours it out over the dorsal surface of the body. *Batrachoseps* is eaten with avidity by snakes, *Plethodon* is not rejected, and *Diemyctylus* does not appear to be taken at all as food. On the other hand, *Batrachoseps* practises autotomy on little provocation and at almost any point, *Plethodon* only as a last resort and at one region only, *Diemyctylus* not at all.

Skulls of Teleosts in Relation to Mode of Life.‡—F. Supino points out that some cranial characters of Teleosts, notably the amount of cartilage or bone in certain regions, may be correlated with the mode of life.

Gills and Teeth of Comephorus.§—A. Korotneff notes some peculiarities in the gills and teeth of this fish from Lake Baikal. The gill arches are four in number: they possess on their inner edge specialised papillæ, which bear long shield-shaped teeth; on their outer edge, lancet-shaped gill plates, which are covered on both sides with gill lamellæ. In the axis of the gill plate there runs a rod of cartilage, accompanied by an artery and vein. At the point of origin of the gill lamella from the plate, and on its inner side, there arises from the vein a sinus venosus. On the border of this sinus there runs a delicate artery, supplying the artery of the gill leaf. On the flat side of the gill lamella a capillary net communicates on one side with the vein lacuna and on the other probably with the above-mentioned artery. The teeth develop from a mesoderm papilla which projects into the epithelium. Around it the inner layer of the many-layered epithelium forms a cap of prismatic cells, while between the epithelium and the papilla, cement, to which a mesodermic origin is to be ascribed, is laid down. An upward growth of the whole takes place, while the papilla enlarges, the cement increases, and the cap cells become long and thread-like. It is doubtful if enamel is present. In origin the teeth are suggestive more of Ganoids than of bony fishes.

Structure of the Swim-Bladder.‖—D. Deineka makes an addition

* Zool. Anzeig., xxviii. (1904) pp. 404–5 (1 fig.).
† Univ. California Publications, i. (1903) pp. 157–70 (1 pl.).
‡ Atti. R. Accad. Lincei (Rend.) xiii. (1904) pp. 625–31.
§ Biol. Centralbl., xxiv. (1904) pp. 641–4.
‖ Zeitschr. wiss. Zool., lxxviii. (1904) pp. 149–64 (2 pls.).

to the steadily increasing literature of this subject. He discusses the work of earlier writers, and seeks to bring his own into line with it. He has experimentally demonstrated the hydrostatic function of the organ, but cannot say if it is an active one—whether the quantity of gas is capable of being lessened or increased at need—or whether mechanical as a result of its position. The composition of the gases receives attention, and also the nerve supply and structure of the bladder, particularly the blood vessels and gland cells. In the blood glands there are remarkable giant cells, resembling those of the bone marrow. On a surface view these are seen to be disposed irregularly, and are so large that they frequently occupy the whole thickness of the cellular layer of the gland. Each cell is beset by a close network of vessels. These cells are particularly numerous in young fishes, and they appear to give rise, by amitotic division of the nucleus, to the small cells of the gland.

Swim-Bladder of Fishes.*—A. Jaeger finds that there are three kinds of arrangement in the swim-bladder of fishes for regulating the quantity of gas. The "red-body" liberates oxygen (which is the only element to be considered in an increase of air in the bladder) from the blood. The lessening of the quantity of air is effected in fishes with closed bladder through the absorption of oxygen by means of the "oval," in others with open bladder by its escape through the duct. The inner epithelial lining of the bladder is impermeable to oxygen. Through the regulating mechanism described, the changing water-pressure is neutralised so that, at all depths, the volume of the fish is the same, and its specific gravity equal to that of the surrounding medium.

Inferior Pharyngeal Bones in Genus Orestias.†—J. Pellegrin finds considerable differences in the character of the teeth in different species of this genus, which are adaptations to diverse feeding habits. A specialised food, composed of small strong-shelled molluscs which are difficult to crush, has led to the transformation of narrow alveolar surfaces into conical teeth, with considerable augmentation of the alveolar surface. In species which feed on softer vegetable or animal substances, there are large alveolar surfaces, with granular rounded teeth, and a marked tendency to fusion of the inferior pharyngeals.

Australian Fossil Fishes.‡—F. Chapman and G. B. Pritchard give an account of eleven genera, represented by twenty-five species of Tertiary Selachia, three of which are new. The ranges of the several forms are tabulated, and some interesting information, pointing to the affinity of the Cretaceo-Tertiary strata of New Zealand and Australia, is adduced.

Food-Fishes of North Sea.§—P. P. C. Hoek, in collaboration with Heincke, Ehrenbaum and Kyle, has given an account of the ten most important food-fishes of the North Sea. Each species is dealt with

* Ber. Senckenberg Nat. Ges. Fr. (1904) pp. 63*-72*.
† Comptes Rendus, cxxxix. (1904) pp. 682-4.
‡ Proc. Roy. Soc. Vict., xvii. (1904) pp. 267-97 (2 pls.).
§ Die Literatur der zehn wichtigsten Nutzfische der Nordsee in monographischer Darstellung. Conseil Internat. Explor. de la Mer, No. 3 (1903) pp. 112 (10 pls.). See Zool. Zentralbl., xi. (1904) pp. 852-3.

monographically, and a plate is devoted to each. This will be a very useful book, as it includes literature, nomenclature, distribution, and what is known as development, as well as a careful morphological account of each form. The ten species are: Mackerel, Cod, Haddock, Whiting, Plaice, *Pleuronectes limanda*, *Solea vulgaris*, Herring, and *Engraulis encrasicholus*.

Fishes of Panama Bay.*—Charles H. Gilbert and Edwin C. Starks enumerate 374 species, of which 43 are new. The new species are described, and there are notes on many of those previously recorded. Of the 374 species recorded from Panama, 204 are now known to occur in the Gulf of California, and further exploration will certainly increase the list of forms common to the two areas, which differ principally in the greater development at Panama of Siluroids and Sciænoids.

Much has been written concerning the close parallelism between the fish faunas on opposite sides of the Isthmus of Panama, and the bearing of this upon the question of a water-way formerly open between the two oceans. The ichthyological evidence is overwhelmingly in favour of a former open communication, which must have become closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved. It is interesting to find definite evidence of the widely varying rates of differentiation. Thus there are 54 identical species; a larger number have become distinguished by minute but constant differences, and by imperceptible gradations we pass to widely divergent species.

Sense of Hearing in Goldfish.†—Henry B. Bigelow has made many experiments, using an ingenious apparatus, to test the sense of hearing in the goldfish (*Carassius auratus*, L.). He tested three sets: (1) normal fishes; (2) those in which the greater part of the integument had been made insensitive by cutting the fifth and seventh nerves, the lateral line nerves, and the spinal cord close to the medulla; and (3) fishes in which the eighth nerve had been cut.

Normal goldfishes usually respond in a definite manner to sound-vibrations in water. Goldfishes in which most of the skin has been rendered insensitive by cutting the nerves, and specimens from which the ears, except the saccular portion, have been removed, still respond in an essentially normal way to sound-vibrations in water. Goldfishes in which the eighth nerves have been cut on both sides, thus eliminating the sacculi and lagenæ as well as the rest of the ear, seldom or never respond to sound-vibrations in water. Goldfishes possess the sense of hearing, and the portion of the ear concerned with this sense is the sac which probably represents the sacculus and the lagena of higher vertebrates.

Maldive Cephalochorda.‡—G. H. Parker finds, in a collection made by A. Agassiz in the Maldives, species representing the three genera

* Mem. California Acad. Sci., iv. (1904). Contributions from Hopkins' Laboratory, xxxii. (1904) pp. 1–304 (33 pls.).

† Amer. Nat., xxxviii. (1904) pp. 275–84.

‡ Bull. Mus. Comp. Zool. Harvard, xlvi. (1904) pp. 39–52 (2 pls.).

Branchiostoma, *Heteropleuron*, and *Asymmetron*, namely *B. pelagicum* Günther, *Heteropleuron maldivense* Cooper, *H. agassizii* sp. n., *H. parvum* sp. n., *Asymmetron orientale* sp. n., and *A. macricaudatum* sp. n. —a somewhat remarkably rich material from three localities in the Maldives.

River Plankton.*—C. A. Kofoid has made an extensive study of the plankton of the Illinois river for the years 1894 to 1899. The period of minimum productivity of plankton is in January and February; this is followed by rising productivity which reaches its maximum in April, after which there is a gradual decline. Area and depth show little relation to plankton production, but fluctuations in hydrographic conditions, temperature and light are important. Young waters from springs and creeks have little plankton, but develop an abundant one when impounded in backwater reservoirs. Submerged vegetation tends to diminish the production of plankton.

Plymouth Marine Invertebrate Fauna.†—A useful and interesting list of the Plymouth marine invertebrate fauna has been compiled from the records of the laboratory of the Marine Biological Association. The various grounds are described, and the local distribution of species is recorded.

Tunicata.

Studies on Tunicates.‡—D. Damas discusses in particular the branchial region in Tunicates, the definition of the protostigma, the number of protostigmata in various types (which he calls poly-, hexa-, tetra-, di-, and mono-prostigmata), the development of the branchial apparatus in these types, and so on. He holds firmly to the proposition that Tunicata have but one pair of branchial clefts, in the strict sense. The paper also includes a discussion of the segmentation of the tail of Appendicularians. In *Oikopleura dioica* there are ten muscle-plates, each innervated by a motor nerve, and apparently representing true segments. Finally, the author has some interesting notes on the structure of the larva of *Distaplia magnilarva*.

Physiological Polarisation in Ascidian Heart.§—F. W. Bancroft and C. O. Esterly describe certain experiments upon the heart of *Ciona intestinalis*, from which they conclude that not only does the direction of the contractions remain fixed, while a part of the heart is connected with only one of its ends, but that in some way a change is effected in the heart tissue, so that the direction of the contractions still remains fixed after the part has been isolated from the end which was instrumental in producing the fixation. The heart tissue becomes physiologically polarised by being left in contact for a while with only one end of the heart.

* Bull. Illinois State Lab. Nat. Hist., vii. pp. 95–629 (50 pls.). See Amer. Nat., xxxviii. (1904) p. 397.
† Journ. Marine Biol. Assoc., vii. (1904) pp. 155–298 (1 chart).
‡ Arch. Biol., xx. (1904) pp. 745–833 (4 pls.).
§ Univ. California Publications, i. (1903) pp. 105–14.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Germinal Layers in Gastropods.*—T. Fujita has studied the formation of the germinal layers in *Siphonaria lepida* and in *Aplysia*, and compares his results with those attained by others. Throughout the cleavage there is no fixed regularity, such as is expressed in the so-called law of alternation of spirals as stated by Wilson, Kofoid and others. There is, however, a spiral arrangement or symmetry for some time. It is abruptly transformed in an interesting manner into a bilateral symmetry, just after the cells of three germ-layers are distinguishable. The author follows the lineage on to the 50-cell stage, and sums up in a table of cell-generations, which he compares with similar tables of *Neritina*, *Umbrella*, and *Limax*.

Maturation in Nudibranchs.†—W. M. Smallwood has studied the eggs of *Doris bifida*, *Montagua gouldii* and *M. pelosa*, at Wood's Hole, Mass.

The chromatic substance is differentiated into basi-chromatin and oxy-chromatin. The former gives rise to the chromosomes; the latter passes into the cytoplasm, to contribute in part to the formation of the sphere substance.

No evidence of chromosome vesicles was found during the prophase of the first maturation, as is the case in *Haminea solitaria*. But during the "rest-pause" between the first and second maturation, the chromosomes frequently have distinct vesicles.

The egg chromosomes enclosed in vesicles change while in this state, until each vesicle has the appearance of a miniature nucleus. Before the metaphase of the second maturation, the several chromatic granules unite into a solid mass, the vesicle probably disappearing. The facts observed strengthen the growing conviction that the theory of the qualitative division of the chromosomes is untenable.

Fertilisation takes place in the oviduct, the tail remaining outside. The sperm head becomes vesicular during its progress towards the animal pole; and while it is undergoing this change one or more chromosome vesicles may be formed, in connection with the chromatin derived from the sperm, which are similar to the egg chromosome vesicles. These vesicles arise undoubtedly through the influence of the chromatin on the cytoplasm, and this fact suggests that the vesicles in the three Nudibranchs investigated are not identical with those in *Haminea solitaria*, which arise in the nucleus.

Magellan Species of Trophon.‡—H. Strebel reports on the species of *Trophon* from the Magellan province collected by the Swedish Expedition (Nordenskjöld), the Scotia Expedition (Bruce), by Michaelsen, by

* Journ. Coll. Sci. Univ. Tokyo, xx. Article 1 (1904) pp. 1–42 (3 pls.).
† Morphol. Jahrb., xxxiii. (1905) pp. 87–105 (1 pl.).
‡ Zool. Jahrb., xxi. (1904) pp. 171–248 (6 pls.).

Paessler, and others. It is satisfactory to have a number of collections of similar material dealt with at once. Fourteen new species are described; and the growth-changes and variations of *Trophon geversianus* are dealt with in detail, with abundant illustrations.

Arthropoda.

Insertion of Muscles on the Skeleton of Arthropods.*—R. H. Stamm has made a precise study of the way in which the muscle fibres become attached to the chitinous skeleton in insects and crustaceans.

a. Insecta.

Sense of Hearing in Insects.†—Em. Rádl maintains that the sense of hearing exists in insects, but on a simpler basis than in higher vertebrates. The structural and functional basis is not to be looked for in the tactile organs, of which there are many sorts, but in the chordonotal organs which are in close association with muscular activity. Hearing in insects is a refined muscular sense.

Development of the Gut in Insects during Metamorphosis.‡—P. Deegener has elucidated the following facts from a study of *Cybister roeselii* Curtis. The mid-gut epithelium of old larvæ is thrown off at the time of its transformation into the pupa, and is replaced provisionally by a "*Kryptenhals-epithel.*" This provisional epithelium is soon pushed into the gut lumen, and, with the remains of the active epithelium, forms the "yellow body" of the larva. The larval basal membrane is preserved during these changes. In the later stages of the larva an epithelium peculiar to the pupa is developed, whose function is limited to the "yellow body" of the larva. The pupa epithelium is built up of the imaginal cells of the larval "*Kryptenschläuche,*" and towards the fourth day of the pupal period it approaches dissolution. Subsequently the pupa epithelium, along with the larval basal membrane, occupies the inner region of the imaginal mid-gut, whose wall is formed of imaginal cells. This epithelium, which is separated from the imaginal islands, forms the "yellow body" of the pupa. An analogous shedding of the epithelium of the other regions of the gut, and also of the gut musculature takes place.

Wax-glands in Meliponidæ.§—L. Dreyling concludes, from a study of the structure and development of these glands in *Melipona quinquefasciata*, that they are fundamentally similar to those of the honey-bee, and are to be distinguished from these only by their dorsal position.

Hypopharynx of Hymenoptera.‖—Max Hilzheimer has studied the "hypopharynx" of Hymenoptera, which is never rudimentary as in many other insects, e.g. Coleoptera, but is often so strongly developed that it can bear masticating organs, as in Thysanura and Poduridæ. As regards the hypopharynx, the Hymenoptera represent an early divergence from the primitive insect stock.

* Mem. Acad. Roy. Danemark, Copenhagen, 7th series, i. pp. 127–64 (2 pls.).
† Biol. Centralbl., xxv. (1905) pp. 1–5.
‡ Zool. Jahrb. (1904) xx. pp. 499–676 (11 pls.).
§ Zool. Anzeig., xxviii. (1904) pp. 204–10.
‖ Jenaische Zeitschr. f. Naturwiss., xxxix. (1904) pp. 119–50 (1 pl.).

Accessory Glands of the Silk-Producing Apparatus in Caterpillars.*—L. Bordas has studied the complex and very variable accessory glands which are associated with the silk-glands in the larvæ of many Lepidoptera, which probably serve, when functional, to agglutinate or strengthen the silk threads.

Modifications in the Development of Lepidoptera.†—Arnold Pictet notes that the winter-pause exhibited by embryos, larvæ, or pupæ, is, in part, an expression of the hereditary constitution, for it occurs even when the temperature is artificially kept from falling low. It is not possible to suppress altogether the hibernal pause, but in *Lasiocampa quercus* artificial raising of the temperature alters entirely the normal duration of the various stages.

Experiments in altering the diet of *Ocneria dispar*, etc., show that the rate of development and the pigmentation can be greatly modified. It is interesting to find that albino-forms have a pupal life shorter than the normal, and that melanic forms have a pupal life longer than the normal.

In sexually dimorphic forms, bad nutrition results in regressive males, like the females in colouring; while rich nutrition results in progressive females, like the males in colouring.

Is there a Relation between Size of Eggs and Sex in Lepidoptera?—L. Cuénot ‡ has made observations on the sex of the progeny from large and from small eggs of *Bombyx mori* and *Ocneria dispar*. Both sets give rise to approximately similar numbers of males and females. There seems to be *no* causal relation between the *volume* of the ovum and the sex of the product. Quajat (1903) has shown that there is no relation between the *density* of the ova of *Bombyx mori* and the sex of the progeny. The facts, so far as they go, which is not very far, tell against the theory of *progamic* determination of sex.

Mosquitos of New York State.§—E. P. Felt has issued an important bulletin calling attention to the more important species which occur in New York State, and giving keys and illustrations for their identification. Special attention is given to establishing the identity of both larvæ and adults. Much important information concerning their life histories, haunts and breeding places, their migrations, distribution and natural enemies, is given.

Some New Sense-Organs in Diptera.‖—W. Wesché finds that the antennæ and palpi of insects are capable of receiving the stimulus of several senses, and that their capacities differ greatly in different species. Taste-hairs, homologous with Kræpelin's taste-hairs in Muscidæ, are found in various orders of insects. What are believed to be typical olfactory organs are described in *Gastrophilus equi*, *Stratiomys chameleon*, and *Bibio hortulanus*. Three new organs, probably sense-organs, are described.

* Comptes Rendus, cxxxix. (1904) pp. 1036–8.
† Arch. Sci. Phys. Nat., xviii. (1904) pp. 608–12.
‡ Arch. Zool. Exper. iii. (1904), Notes et Revue, No. 2, pp. xvii.–xxii.
§ New York State Museum, Bulletin 79 (19 0 241–400 (57 pls.).
‖ Journ. Quekett Micr. Club, ix. (1904) pp. 91–104 (2 pls.).

Coffee Beetle.*—L. Boutan discusses the formidable "Indian Borer" *Xylotrechus quadrupes* C., which threatens to ruin the coffee-plantations at Tonkin. It is a longicorn beetle, which lays eggs in the cortex of the coffee-plant. Remedial measures are discussed, and the surrounding of the stems with thick bandages to prevent emergence is especially recommended. Anything that keeps the stem persistently moist seeems to be efficacious in hindering the development of the eggs.

Maternal Instinct in Rhynchota.†—F. P. Dodd gives an interesting account of the brooding habits of the female *Tectocoris lineola*, var. *banksi* Don. This bug sits in a brooding attitude over her eggs for three weeks, and that without feeding, until the young are hatched. When the young begin to break through, the mother backs an inch or so away from the egg mass, and stays there for some hours (long after the last egg has hatched); she then departs, leaving the small bugs to take care of themselves. The author thinks that this protection has in some measure for its object the keeping off of ichneumon flies.

Development of Head Skeleton in Cockroach.‡—W. A. Riley has studied the development of the head of *Blatta germanica* with especial reference to the skeleton. His views in regard to the relations of the sclerites of the adult *Blatta* to the primitive segments are summed up in the following table:—

Segment.	*Sclerites.*
Protocerebral . .	Vertex, genæ. Front, clypeus and labrum.
Deutocerebral . .	Antennal sclerites.
Tritocerebral. . .	—
Mandibular . . .	Part of post-genæ, trochantins. Part of hypopharynx.
Maxillary . . .	Remainder of post-genæ, maxillary pleurites. Remainder of hypopharynx.
Labial	Labial pleurites; lateral cervical sclerites. Ventral cervical sclerites.

It would seem that the definitive sclerites afford little or no evidence as to the primary segmentation of insects. This is certainly true of the head sclerites, and probably applies to other regions of the body. Sclerites originate from mechanical causes, and do not necessarily have any relation to the primary segmentation.

Thorax of Gryllus Domesticus.§—F. Voss, as a preliminary to the elucidation of the question of the morphological significance of the insect's wing, gives a detailed account of the skeleton of the thorax, and of the wing joint and its movement.

In a subsequent paper ‖ he gives a most painstaking and exact study of the skeletal parts and musculature of the thorax of the cricket, with special reference to the wing-articulation and wing-movement.

* Comptes Rendus, cxxxix. (1904) pp. 932-4.
† Trans. Entomol. Soc. London, 1904, pp. 483-6 (1 pl.).
‡ Amer. Nat., xxxviii. (1904) pp. 777-810 (12 figs.).
§ Zeitschr. wiss. Zool., lxxviii. (1904) pp. 268-354 (2 pls.).
‖ Op. cit. (1905) pp. 355-521 (2 diagrams and 15 figs.).

Palmén's Organ in Ephemerids.*—J. Gross discusses this remarkable structure in *Ephemera vulgata* L. It is a roundish body, with concentric layers of chitin, and lies on the roof of the head where four tracheæ meet. No nerve endings were found, but the suggestion is made that the puzzling structure may be an equilibrating or orientating organ.

Monograph on Lepismatidæ.†—K. Escherich has supplied a much-needed critical monograph on this family of Thysanura, which is so important in relation to higher insects. He discusses the segmentation of the body, the integument with its scales, bristles, teeth and spines, and the various appendages. There is an interesting chapter on habits, both of those which live freely and of those which live in association with ants and termites. Those which occur in houses—*Lepisma saccharina*, *Thermobia domestica*, and *Acrotelsa collaris*—are especially referred to. The bulk of the memoir is, of course, systematic. The first subfamily, Lepismatinæ, includes *Lepisma*, *Isolepisma*, g. n., *Heterolepisma*, g. n., *Silvestrella*, g. n., *Braunsina*, g. n., *Lepismina*, *Ctenolepisma*, g. n., *Thermobia* and *Acrotelsa*, g. n. The second sub-family Nicoletiinæ includes *Atelura*, *Lepidospora*, g. n., *Nicoletia* and *Trinemophora*. The third sub-family Maindroniinæ includes the single genus *Maindronia*.

Collembola of Lapland.‡—H. Agren reports on the first collection of Collembola from Lapland. It was made by S. Bengtsson in 1903. Twelve species occur in Lapland which are known from the Palæarctic region generally; *Isotoma bidenticulata* is restricted to Arctic and Alpine areas; nine species occur which have hitherto been known only from regions to the south of Lapland; *Achorutes lapponicus* Axels, and six new species, may be provisionally regarded as characteristic of Lapland; but no specifically Arctic species was discovered.

Ventral Tube of Tomoceros.§—R. W. Hoffmann describes in considerable detail the structure and relations to the head glands of this tube which develops from a pair of abdominal legs. It functions mainly as an adhesive organ, but appears to be capable of assisting in respiration.

δ. Arachnida.

Spiders of the Erigone Group.‖—Frank P. Smith indicates the extent and constitution of the "*Erigone* Group" of British spiders, embracing the genera *Œdothorax*, *Stylothorax*, *Coryphæus*, *Gongylidium*, *Gongydiellum*, *Trachygnatha*, *Erigonidium* g. n., *Gonatium*, *Enydia* (nomen novum), *Falconeria* g. n., *Dismodicus*, and *Typhochræstus*.

Fossil Scorpion from Lancashire.¶—W. Baldwin and W. H. Sutcliffe describe from the middle coal-measures of Lancashire, near Rochdale, a new species of scorpion, *Eoscorpius sparthensis*. The specimen occurred within a clay-ironstone nodule. The authors make some com-

* Zool. Jahrb., xix. (1903) pp. 91–106 (1 pl. and 3 figs.).
† Zoologica, xviii. (1905) heft 43, pp. 1–164 (4 pls. and 67 figs.).
‡ Arkiv f. Zool. (K. Svenska Vetensk. Akad.) ii. (1904) pp. 1–30 (2 pls.).
§ Zool. Anzeig., xxviii. (1904) pp. 87–116.
‖ Journ. Quekett Micr. Club, ix. (1904) pp. 109–16.
¶ Quart. Journ. Geol. Soc. (1904) pp. 394–9.

parisons with other species, and discuss the geological bearing of their discovery.

Secretion in Female Gonads of Hydrachnids.* — Karel Thon recalls a communication made by Balbiani, † in 1897, on the secretory capacity of the epithelium of the female gonads of spiders. In studying *Eulais*-nymphs, Thon found that the interior of the gonads was full of large, tough, glassy concretions, produced at the time of the appearance of the first oocytes. The whole vicinity of the gonadial tubes was crowded with leucocytes filled with large granules. It almost seems as if the leucocytes were accumulating excretions from the gonads, but definite proof is lacking.

Two New British Water-Mites.‡—C. D. Soar describes a new genus *Pseudofeltria*, allied to *Feltria*, and *Mideopsis crassipes* sp. n. with very thick legs.

Minute Structure of the Tick.§—Erik Nordenskiöld fills some gaps by a brief communication dealing with the alimentary system, excretory organ, blood, and musculature of *Ixodes reduvius*. The intestinal musculature, which previous investigators have missed, can be readily seen in sections. The salivary glands show some remarkable cellular peculiarities. The excretion in the lumen of the excretory organ occurs in the form of drops and peculiar spherical granules of guanin.

ε. Crustacea.

Rudimentary Gill in Astacus Fluviatilis.‖—M. Moseley describes a minute rudimentary gill in *A. fluviatilis* Fabr., in a position which appears to correspond to the arthrodial membrane of the seventh somite—that of the first pair of maxillipeds. It is not present in other species of *Astacus* examined by the writer, e.g. *A. torrentium*, *A. pallipes*, or *A. leptodactylus*, nor in various related genera. It appears to be feebly represented in *A. dauricus* from Corea.

Heteromorphism in Rock Lobster.¶—V. Ariola describes a case in *Palinurus vulgaris* in which the left eye-stalk was represented by an antenna-like structure, 16 centimetres in length. The regenerated structure resembled the exopodite of an antennule, but with more numerous joints. He regards this as an atavistic reversion. But it is doubtful whether the antennules are homologous with ordinary appendages. It may be that the antennules and the eye-stalks are not strictly in line with the appendages, or that one is and the other is not.

Fresh-water Decapods of Celebes.**—J. Roux gives a detailed comparison of the species of *Caridina* and of *Potamon* from this region, together with notes on their distribution in the Malay Archipelago.

* Biol. Centralbl., xxv. (1905) pp. 83–92 (3 figs.).
† Archives d'Anatomie Microscopique, i. (1897).
‡ Journ. Quekett Micr. Club, ix. (1904) pp. 105–8 (2 figs.).
§ Zool. Anzeig., xxviii. (1905) pp. 478–85 (7 figs.).
‖ Quart. Journ. Micr. Sci., xlviii. (1904) pp. 359–66 (2 pls.).
¶ Arch. Entwicklungsmechanik, xviii. (1904) pp. 248-52 (1 pl.). See Zool. Zentralbl., xi. (1904) pp. 830–2.
** Revue Suisse Zool., xii. (1904) pp. 539–72 (1 pl.).

The genus *Potamon*, for example, is mostly localised in one island and in a definite area of it. In Celebes there are seven species, and of one o: these there are nine varieties.

Nereicola ovata Keferstein.*—Mario Stenta communicates a not on the occurrence of this interesting parasitic Copepod (representing family in the tribe Isokerandria, in the sub-order Podoplea) whic infests *Nereis cultrifera*, *N. dumerilii*, etc.

Pycnogonids of Bermuda.†—Leon J. Cole reports on the fe Pycnogonids discoverable at the Bermuda Islands, viz. *Ammothea graci* Verrill, *Ammothella appendiculata* Dohrn, and *Anoplodactylus insign bermudensis* sub-sp.n. There are strong tidal currents; how is it th the Pycnogonids are not all swept away? The adults cling tenaciou to the hydroids, but the danger comes to the eggs and larvæ. The eg are taken directly from the female by the male, and, as is well kno are carried by him until they are hatched. The newly-hatched larva *Ammothea* and related forms bear a large pair of chelæ on the en mously developed cheliferæ, and are thus enabled to cling to the par or to hydroids and similar objects. The most striking character of : Bermuda sub-species of *Anoplodactylus insignis* is its protective and yellow coloration, which closely resembles *Obelia marginata* Allm. to which it often clings.

Annulata.

Notes on Polychæta.‡—W. C. M'Intosh, in his twenty-sixth tribution of notes from the Gatty Marine Laboratory, St. Andr discusses: (1) Pacific, Atlantic and Japanese "Palolo," and analo phenomena exhibited in British waters by *Nereis dumerilii*, *N. longis* and other forms; (2) the families Goniadidæ, Glyceridæ, and Ari as represented in Britain, in the "Porcupine" collection, in the Gu St. Lawrence (Whiteaves), off Norway and Finmark (Norman): (3) the form described in the "Challenger" report as *Hemipodu magellanicus*, for which a new generic title—*Glycerella*, as sugges Arwidsson—is required.

New British Sabellarian.§—E. J. Allen describes *Pallasia n* sp. n. from Plymouth. The new worm most closely resembles *Pa giardi* M'Intosh, from Port Jackson in Australia, and *P. laev.* Grube, from Upolu in the Pacific, and from Ascension. The det its structure, as well as the large size (5 inches) of the British spe indicate that it is a new species. The paper includes an inte note, by Arnold Watson, on the structures which surround the m

Alleged Otocysts of Alciopidæ.‖—P. Fauvel points out th structures described by Béraneck as otocysts, on the first and

* Boll. Soc. Adriat. Sci. Nat. Trieste, xxii. (1904) pp. 195–201.
† Proc. Boston Soc. Nat. Hist., xxxi. (1904) pp. 315–28 (3 pls.).
‡ Ann. Mag. Nat. Hist., xv. (1905) pp. 33–57 (1 pl.).
§ Journ. Marine Biol. Ass., vii. (1904) pp. 299–304 (1 pl.).
‖ C. R. Ass. Franç. Avanc. Sci. Congrès d'Angers (1903) pp. 784–8. S Zentralbl., xi. (1904) p. 822.

body-segments of Alciopidæ, are really receptacula seminis occurring only in the females, and formed by hypertrophied dorsal cirri.

Xerophilous Enchytræidæ of Switzerland.*—K. Bretscher discusses the distribution of those Enchytræidæ which frequent damp earth occasionally covered by casual water. Their number is surprisingly large, for he deals with fifty species, largely of his own definition, representing seven genera, *Henlea*, *Buchholzia*, *Bryodrilus*, *Mesenchytræus*, *Enchytræus*, *Fredericia* (12 species), and *Achæta*.

Digestive Apparatus of Aulastoma.†—C. Spiess has investigated the histology of the alimentary tract in *Aulastoma gulo*. There is no reservoir, as in *Hirudo*; there is highly developed epithelial differentiation, whereby a buccal cavity, œsophagus, stomach, and intestine are severally distinguishable. The wall throughout the whole length consists of a connective and epithelial layer, corresponding to the mucous coat of the vertebrate digestive tract. The œsophagus does not, as in *Hirudo*, assist in digestion, but the intestinal epithelium possesses glands which secrete digestive ferments. They are unicellular, and are intermediate between glandular epithelial cells and the pluricellular glands of the intestine of the higher vertebrates. A true stomach, histologically different from the other parts of the tract, is present. Details of its glands are also given in the paper.

Metamerism of Hirudinea.‡—N. Livanow discusses the difficult problem of the somites (neurosomites and myosomites) of Hirudinea.

Nematohelminthes.

Acanthocephala of Birds.§—L. de Marval has revised the list of described forms of Acanthocephala occurring in birds, with the result that the number of species is considerably reduced. Brief diagnostic descriptions of the species with their synonyms are given, and from these diagnoses all references to the hosts are intentionally omitted.

Oxyuris Vermicularis in Peritoneal Cavity.‖—P. Schneider gives an account of a cyst from the peritoneal cavity of a woman 30 years of age. It contained the remains of a mature female *Oxyuris vermicularis*, with ova. The author discusses the question of its migration thither.

Blood-Coagulating Substance in Anchylostoma.¶—L. Loeb and A. J. Smith have shown experimentally that in the anterior half of the body of *A. caninum* a substance is present which strongly hinders the flow of blood, and whose effect is similar to that of *Hirudo in vitro*. The substance is not altogether destroyed by boiling. They failed to prove any hæmolytic action on the part of extracts of these animals, but consider that the coagulating effect has some bearing upon the anæmia frequently observed in *Anchylostoma* infection.

* Biol. Centralbl., xxiv. (1904) pp. 501-13.
† Revue Suisse Zool., xii. (1904) pp. 585-647 (2 pls.).
‡ Zool. Jahrb., xix. (1903) pp. 29-90 (5 pls.).
§ Revue Suisse Zool., xii. (1904) pp. 573-83.
‖ Centralbl. Bakt. Parasitenk., xxxvi. (1904) pp. 550-4.
¶ Op. cit., xxxvii. (1904) pp. 93-8.

Alleged Toxic Action of Intestinal Parasites.*—L. Jammes and H. Mandoul have endeavoured, by observation and experiment, to arrive at some definite conclusion on this subject. Their decision is against the theory of toxic action. The influence of the parasites is mainly mechanical, and their irritation leads indirectly to secondary morbid results.

Notes on Nematodes.†—Von Linstow gives an account of the cloaca in the male of *Heterakis distans* Rud., an intestinal parasite of monkeys. He has notes on *Mermis piscinalis* sp. n., *Neomermis macrolaimus* g. et sp. n., *Chordodes betularius* sp. n., free living forms. From the sturgeon he reports a new Trematode, *Erpocotyle circularis* sp. n., and a new Cestode, *Ichthyotænia skorikowi*.

Researches in Helminthology and Parasitology.‡—J. Leidy, jun., has collected and issued in a useful form the verbal communications, short papers, and elaborate memoirs, of the late Professor Leidy, which have appeared in various journals from 1845 to 1891. A bibliographical list, with 599 references, and a complete index to the parasites considered in the volume, are attached.

New Helminths from West Africa.§—O. von Linstow describes from the gut of *Erinaceus albiventris*, from Nigeria, *Physaloptera dispar* sp. n., *Echinorhynchus cestodiformis* sp. n., *Tænia voluta* sp. n., and from the cæcum of *Anas boschas fera*, near Göttingen, *Tænia* (*Hymenolepis*) *voluta* sp. n.

Platyhelminthes.

Echinococci of Domestic Animals.‖—G. Lichtenheld has made a statistical statement as to the distribution of echinococci in the several organs of the horse, ox, pig, and sheep, together with particulars of the histological features of both sterile and fertile forms. He finds that in older animals the percentage infesting the liver is distinctly smaller than in younger forms, while of other organs infected it is correspondingly higher. Of the total oxen examined, 69 per cent. of the parasites were found in the lungs; of horses, 94 per cent. in the liver; of sheep, 52 and 45 per cent. in lungs and liver respectively; boars yielded 74, and sows 72 per cent. respectively from the liver. Other organs infected were spleen, kidney, heart, and sub-peritoneal tissues. The connective tissue envelope of echinococci arises from a reactive inflammation of the infected organ. In sterile echinococci the inner layer retains its cellular character; in the fertile, the inner layers are transformed into fibrous tissue, while the outer gives rise to a new formation of cellular elements. Of the young undeveloped echinococci, the author regards those which have led to necrosis of the surrounding delicate cells, and to the development of a strong connective tissue envelope, as a first stage of the fertile; and all the others as a first stage of the sterile.

* Comptes Rendus, cxxxviii. (1904) pp. 1734–6.
† Arch. Mikr. Anat., lxiv. (1904) pp. 484–97 (1 pl.).
‡ Smithsonian Miscellaneous Collections, Washington, xlvi. (1904) pp. 1–281.
§ Centralbl. Bakt. Parasitenk., xxxvi. (1904) pp. 379–83 (1 pl.).
‖ Tom. cit., No. 4, pp. 546–50, and xxxvii., No. 1, pp. 64–72 (1 pl.).

Dibothriocephalus latus in Dogs.*—S. von Ratz discusses the problem of the presence of this parasite in dogs in Hungary, where it appears to be not uncommon.

Amitosis in Cestoda.†—C. M. Child gives the results of observations on the development of the gonads in *Moniezia*. These arise mainly by amitotic division of nuclei in the syncytium of the parenchyma. A few isolated instances of mitosis appear to occur, but they are comparatively rare. The case here presented indicates the existence of a relation between amitosis and nuclear activity; and in general a relation between amitosis and degeneration exists only in so far as in regions or periods of intense nuclear activity many nuclei, in some cases perhaps all, are likely to degenerate. The nuclear degeneration of the testis in *Moniezia* is probably a case in point. The author further points out that there is here an instance of cells which pass through a long history of amitotic division, and are yet capable of giving rise to sexual cells. It is difficult to see how the hypothesis of the individuality of the chromosomes can be maintained. A study of the facts in *Moniezia* seems to indicate that there is no fundamental and continuous distinction between tissue cell and germ cell.

Cestodes of Mammals.‡—J. Bourquin discusses *Bertia studeri* R. Blanchard, from the chimpanzee; *B. elongata* sp. n., from *Galeopithecus*; and *B. plastica* (Sluiter) Stiles, from *Galeopithecus*. He gives a revised diagnosis of the genus *Bertia*.

Gonads of Tænia sinuosa§.—T. B. Rosseter describes the genital organs of this tape-worm, which he obtained from the intestine of a duck which he fed with cysticercoids from Ostracods. The spicules of this tape-worm have led the author to the extraordinary conclusion that there is a close affinity between Cestodes and Sponges.

New Trematodes.‖—O. Fuhrmann describes *Bothriogaster variolaris*, the type of a new genus, from the gut of *Rostrhamus sociabilis*, a South American falcon; *Echinostomum armatum*, a new species, from the same animal, and which is different from those hitherto known from birds of prey; *Echinostomum inerme*, sp. n., from the stomach of an unknown species of *Lutra*.

Degeneration of Gonads in Starved Planarians.¶—F. Stoppenbrink has experimented with *Planaria alpina* and *P. gonocephala*. The size may be reduced by three-fourths in nine months of starving. The gonads degenerate in the inverse order of their development, and the general result formulated by Barfurth is confirmed, that the relatively less important organs for self-preservation are first affected and most seriously reduced.

* Centralbl. Bakt. Parasitenk., xxxvi. (1904) pp. 384–7.
† Anat. Anzeig., xxv. (1904) No. 22, pp. 545–58.
‡ Zool. Anzeig., xxviii. (1905) pp. 417–19.
§ Journ. Quekett Micr. Club, ix. (1904) pp. 81–90 (1 pl.).
‖ Centralbl. Bakt. Parasitenk., xxxvii. (1904) pp. 58–64.
¶ Verh. Nat. Ver. Rheinland, lxi. (1904) pp. 27–36.

Nervous System of Tricladidæ from Baikal.*—H. Sabussow has studied species of *Sorocelis* Grube, *Rimacephalus* Korotneff, and *Planaria* Müller, from Lake Baikal, with especial reference to the nervous system. As in other triclads, it consists of a brain, two ventral longitudinal strands, and a nerve plexus in close relation to the integumentary muscular layer, and especially developed on the ventral surface.

The main mass of the longitudinal strands consists of a glia framework, formed from the fibres or lamellæ, secreted from the numerous glia cells. The nerve cells are relatively few, and occur in the spaces bounded by glia cells. A characteristic peculiarity of the nerve cells is the differentiation of fibrillar structures in the protoplasm. The nerve cells seem to be inter-connected by fibrils, passing from one element to another, so that a sort of network is formed.

Excretory System of Fresh-water Triclads.†—J. Wilhelmi supplies some notes on the structure and course of the excretory canals, based on observations on *Dendrocoelum lacteum*, *Planaria alpina*, *P. torva*, *P. gonocephala*, and *Polycelis nigra*. The main and side branches are lined internally by a membrane. The wall consists of a highly granulated, almost homogeneous mass, which passes over without limiting border into the mesenchyme. Flame cells are not present in the main stems of *Dendrocoelum* or *Planaria alpina*. *P. alpina* appears to have a large number of external openings, but the question is difficult to elucidate. The author failed to find the network of vessels described by Chichkoff. Flame cells occur only in the mesenchyme, and not in the gut epithelium. The system in fresh-water triclads resembles in essentials that of Cestodes and Trematodes, but is distinguished from that of both by the mode of opening and the absence of transverse anastomoses. In the course of the main stems, the segmental arrangement of the clump formations, and dorsal openings, the fresh-water triclads resemble the marine *Gunda segmentata*.

Viviparity in the Eumesostominæ.‡—E. Sekera describes and discusses the significance of viviparity exhibited by *Mesostoma ehrenbergi*, *M. lingua*, etc. The young, arising from summer eggs, break through the mother's body at some point which can heal readily. The parent's vitality is unimpaired, and she produces resting eggs later. These summer animals do not usually produce summer eggs. The author considers the formation of the summer eggs, and the accompanying viviparity as a parallel phenomenon with asexual reproduction by division, as seen in the Stenostomidæ and Microstomidæ, whereby a very rapid and abundant multiplication of individuals is effected.

Rotifera.

Three New Parasitic Rotifers.—Sebastiano Piovanelli § describes *Distyla branchicola*, a new parasitic species, living, in company with the two Bdelloids previously described, in the branchial cavity of the

* Zool. Anzeig., xxviii. (1904) pp. 20–32 (4 figs.).
† Tom. cit., No. 7 (1904) pp. 268–72.
‡ Zool. Anzeig., xxviii. (1904) No. 7, pp. 232–43.
§ Monitore Zool. Italiano, xiv. (1903) pp. 345–9.

Mediterranean fresh-water crab *Telphusa fluviatilis*. This new species is said to resemble *Distyla lipara* Gosse, but to differ from it by being more elongate, and by the total absence of an eye. No figure is given.

Stan. Hlava * figures and describes *Albertia bernardi*, a new parasitic species living in the intestine of *Stylaria lacustris* (*Nais proboscidea*). The body is segmented, spindle-shaped, with a wing-like enlargement at the posterior extremity; foot small; no eyes; the head and mastax are small; the species is oviparous.

Raffaele Issel † describes and figures *Balatro anguiformis*, a new species parasitic in the intestine of the Oligochæte annelids *Fredericia bulbosa* and *Henlea ventriculosa*, and which appears to differ from *B. calvus* Claparede, mainly by the absence of the great postero-ventral lobe.

Echinoderma.

Siamese Sea-Urchins.‡—Th. Martensen reports on the regular echinoids collected by the Danish expedition to Siam. Sixteen species are dealt with, of which four are new, viz. *Chæodiadema granulatum*, *Pleurechinus döderleini*, *P. siamensis*, and *Gymnechinus pulchellus*, the first named being the type of a new genus. The author has used this opportunity to revise the classification of the regular echinoids.

Species of Cucumaria from Plymouth.§—S. Pace points out that two species have been hitherto confused as *Cucumaria montagui* Fleming, viz. *C. saxicola* Brady and Robertson, and *C. normani* sp. n.

New Crinoid.‖—W. Minckert describes *Promachocrinus vanhöffenianus* sp. n., a littoral Antarctic form collected by the "Gauss" expedition. He amends the definition of the genus, erects the new genus *Decametrocrinus* [= *Promachocrinus* (pars)] P. H. Carpenter, and suggests the new family Decametrocrinidæ for the two genera. This is the first new discovery of a ten-rayed unstalked Crinoid since the "Challenger" days.

Cœlentera.

Development of Hydranths of Campanularidæ and Plumularidæ.¶—Ormand Billard finds that the rudiment or primordium of the tentacles forms in the young hydranths the outer margin ofl an annual groove, surrounding a papilla which represents the future hypostome. The tentacles, confluent to begin with, are first indicated by strands of endodermic cells; then they appear as slight denticulations; then the interspaces are incised to the level of the groove.

Porifera.

Phylogeny of Hexactinellid Sponges.**—E. A. Minchin, in speculating on this subject, makes the following suggestions. In the ancestral form of these, and perhaps of all sponges, the gastral layer was in the form

* Zool. Anzeig., xxviii. Dec. 1904, pp. 365–8.
† Archivio Zoologico, vol. 2, 1904, pp. 1–9 (1 pl.).
‡ Mem. Acad. Roy. Danemark, Copenhague, 7th Series, vol. i. No. 1 (1904) pp. 1–124 (7 pls. and a map). § Journ. Marine Biol. Ass., vii. (1904) pp. 305–9.
‖ Zool. Anzeig., xxviii. (1905) pp. 490–501 (2 figs.).
¶ Comptes Rendus, cxxxix. (1904) pp. 1038–40.
** Zool. Anzeig., xxviii. (1905) pp. 439–48.

of a continuous sheet of collar-cells, suspended evenly in the midst of the dermal layer, which formed a trabecular system, developed as much towards the interior as towards the exterior of the gastral layer. The spicular skeleton arose first in the trabecular system, situated externally to the gastral layer, and the earliest regular form of spicule was the stauractine. This stage of evolution is represented by the palæozoic Stauractinophora of Schrammen, especially by the Protospongidæ. The next step in phylogeny was the folding of the gastral layer to form distinct flagellated chambers, and with this change the stauractines developed additional rays directed radially, thus producing the hexactines found in all Hexactinellida after the palæozoic epoch, and probably also in many even at that early time.

Genus Raspailia.*—F. K. Pick gives a monographic account of this genus of horny sponges belonging to the family Ectyoninæ. He discusses the history of the genus, gives a systematic account of the species, adding to the list, and describes the structure of the canal-system, skeleton, and so forth.

Studies on the Hexactinellida.†—Isao Ijima makes a fourth contribution of hexactinellid studies, and deals with the family Rossellidæ. He re-defines the family, gives a key to the genera, and treats of about thirty species, five of which are described for the first time. The twenty-three plates are of great excellence.

Protozoa.

Movement and Reactions of Amœbæ.‡—H. S. Jennings has found it possible to determine the exact movements of the outer layer of *Amœba verrucosa*, and others, by causing foreign particles to adhere to the surface. The movements of these particles show that the motion of an amœba is of a rolling character, as Lachmann pointed out in 1858, and Wallich in 1863. A single particle was seen to complete the circuit of the cell many times. It is not merely a thin outer layer that moves forward; on the contrary, the whole substance of the amœba, save that part which is in contact with the substratum, flows forward in a single stream. There is typically no backward current in a progressing amœba. In a free pseudopodium all parts move outward, new portions of the surface of the body continually passing to the surface of the pseudopodium. Thus the movements of amœbæ lose their supposed resemblance to those of a fluid mass moving as a result of a local change in surface tension. The actual movements of an amœba resemble even in details the movements of a drop of fluid which adheres on only one side of the substratum. Purely physical explanations will not work; still less, when we consider cases of an amœba pursuing a spherical cyst of *Euglena* for fifteen minutes. One amœba pursued another for a long time, finally capturing and ingesting it. After being carried for a short distance, the prey partly escaped and was recaptured. It again escaped

* Arch. f. Naturges., lxxi. (1904) pp. 1–48 (4 pls.).
† Journ. Coll. Sci. Univ. Tokyo, xviii. (1904) pp. 1–307 (23 pls. and 10 figs.).
‡ Biol. Centralbl., xxv. (1905) pp. 92–5 (2 figs.). Publication No. 16, Carnegie Inst. Washington (1904) pp. 129–234.

completely, but was pursued, overtaken, recaptured, and again carried away. After five minutes it escaped again, and this time completely, so that the hunter amœba went on its way without its meal.

Contractile Vacuole in Amœba.*—E. Penard describes the mode of liberation of the contents of the contractile vacuole in *A. terricola*. It is always situated near the edge of the plasma, and never breaks till its wall touches the outside pellicle. There is a transformation of the pellicle substance, whereby it becomes porous, and the extrusion to the outside of the contents is made manifest by the appearance outside the amœba of a minute white cloud at the point of contact.

Structure of Radiolaria.†—G. H. Fowler gives some notes on the structure of *Gazelletta* fam. Medusettida. It appears that the "shell-mouth" of *Planktonetta* (a related genus), i.e. a ring round the point of ingestion, is in *Gazelletta* a shell-cap over the extra-capsular protaplasm. The body-shell of *Planktonetta* is not represented in *Gazelletta*. The intrinsic shell in both appears to be the structure here termed the "shell-mouth."

Swarms of Volvox.‡—Otto Zacharias reports from Schwerin an extraordinary "Wasserblüte," due to *Volvox minor* and *V. globator*. There were at times 680 colonies to the litre. Most of them sank deeper at night, and were obviously heliotropic positively, as is well known from laboratory experiments. Those found at night near the surface were mostly young colonies, not yet reproductive.

Fission in Trichonympha.§—Anna Foa gives an account of the flagellate *Trichonympha agilis* Leidy, parasitic in the intestine of *Termes lucifugus*. This flagellate occurs in two forms, a larger and a smaller, which may be different species; and one of the interesting results of the investigation is, that the details of mitosis are different in the two. Thus, in the larger form there are no distinct chromosomes in the chromatin mass.

Two Flagellate Parasites.‖—Anna Foa describes, *Dicercomonas muris* Grassi, from the mouse; and *D. intestinalis* Duj., from the frog. The genus *Hexamitus* of Dujardin must be split into *Hexamitus* Duj., with five known species; *Dicercomonas* Grassi, with two known species; and *Urophagus* Klebs, with two known species.

Giant Trypanosoma in Bovine Blood.¶—A. Lingard gives some particulars of a giant trypanosome which was found in the blood of bovines inoculated with blood containing the small variety of trypanosome, primarily derived from the rat. Before injection into bovines, the small variety was passed by inoculation through the horse and donkey. It appears traceable to the soiled blood of the rat.

* Revue Suisse Zool., xii. (1904) pp. 657–62.
† Quart. Journ. Micr. Sci., xlviii. (1904) pp. 483–8.
‡ Biol. Centralbl., xxv. (1905) pp. 95–6.
§ Atti R. Accad. Lincei (Rend.) xiii. (1904) pp. 618–25 (5 figs.).
‖ Tom. cit., pp. 121–30 (6 figs.).
¶ Centralbl. Bakt. Parasitenk., xxxv. (1903) pp. 234–8 (1 pl.).

Trypanosomes of French West Africa.*—A. Laveran gives an up-to-date summary of our knowledge of the trypanosomes and the mosquitos which disseminate them, together with their areas of distribution in Senegal, French Guinea, Ivory Coast, Sudan, Lake Tchad, and Congo.

Trypanosomes and Leishman-Donovan Bodies.†—L. Rogers describes several stages in the development of these bodies from the spleen in cachexial fevers and Kala-Azar, which show that they belong to the flagellated Protozoa (trypanosomes). He has obtained in cultures from the human spleen, parasites, plasmodial, amœboid and flagellate forms, similar to those found in a variety of animals suffering from the disease produced by *Trypanosoma brucii*.

Trypanosomes in Paddas.‡—M. Thiroux notes that the bird *Padda oryzivora*, inoculated with *Trypanosoma paddæ*, is often found to be infected by *Halteridium danilewskyi*. Experiments show that the presence of these two Protozoan parasites imply double infection. The *Trypanosoma* is very rare in paddas in natural conditions, the *Halteridium* is very common.

Trypanosomes and Tsetse in French Guinea.§—A. Laveran reports that several species of *Glossina*, or tsetse-fly, are abundant throughout French Guinea, where human trypanomyasis, and one or more analogous equine diseases, are rife.

* Comptes Rendus, cxxxix. (1904) pp. 658–62.
† Quart. Journ. Micr. Sci., xlviii. (1904) pp. 367–77 (1 pl.).
‡ Comptes Rendus, cxl. (1905) pp. 109–10.
§ Tom. cit., pp. 75–8.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Spindle Formation in the Pollen-Mother-Cells of Cassia tomentosa.*—H. T. A. Hus finds that the cytoplasm of the young pollen-mother-cells consists of a network of radially arranged fibres, on and between which large and small granules are formed. The meshes next the nuclear wall are smaller and elongated, parallel to the wall. A granular zone appears around the nucleus, and at the same time deeply staining rough fibres, often arranged in conical groups, appear in the cytoplasm. In the next stage a felt-like zone more or less completely surrounds the nucleus, and the deeply staining fibres of the cytoplasm, now united into cones, establish a connection with the fibres of this zone. The linin threads become parallel with the other fibres and also with the axis of the larger cone. As soon as the rough threads of the fibres become smooth the nucleolar wall breaks down, the linin and the kinoplasmic fibres anastomose and become grouped in bundles. A multipolar spindle is formed, two cones of which, opposite to each other, are more prominent, and gradually absorb the smaller cones. The spindle of the second division is more markedly multipolar than that of the first division. The author concludes that the spindle formation in this species forms a connecting link between the multipolar polyarchal spindle *anlage* usually met with in dividing mother-cells of pollen, spore and embryo-sac and the multipolar diarchal spindle *anlage* of vegetative cells.

Structure of the Starch-Grain.†—R. H. Denniston finds in developing starch-grains of various sorts an outer sharply defined layer next the plastid, which takes up orange strongly from the safranin-gentian-violet-orange stain, the body of the grain becoming bright violet. After partial digestion by diastase the grains show the orange-staining layer little affected, while the violet part is much dissolved, and orange-staining material appears in the corroded interior. The author suggests that the outer layer is different from the rest, and believes it to be a carbohydrate not yet fully polymerised to starch.

Structure and Development.

Vegetative.

Regeneration in Zamia.‡—J. M. Coulter and M. A. Chrysler give some account of the remarkable power shown by mutilated stems of

* Proc. Calif. Acad. Sci., iii. pt. 2 (1904) pp. 329–54 (3 pls.). See also W. J. Land in Bot. Gazette, xxxix. (1905) p. 74.

† Trans. Wis. Acad., xiv. (1904) pp. 527–33. See also Bot. Gazette, xxxviii. (1904) p. 473.

‡ Bot. Gazette, xxxviii. (1904) pp. 452–8.

Zamia floridana of producing new shoots and roots. It was stated that portions of the stem not larger than a walnut had been seen to produce both root and shoot. In the stems studied, the new shoots generally spring from the vascular part of the central cylinder, as many as five shoots having been seen to spring from this region in a stem 3 cm. in diameter. The vascular elements are continuous with the vascular tissue of the central cylinder of the parent stem. Less frequently new shoots arise from the peripheral part of the wounded surface of the cortex; both regions of origin may be used in the same stem. The origin of the new roots is just as variable. In several cases they arise from vascular tissue, but, as in the case of shoots, roots may arise from a chip of the cortex of an old vein. The authors conclude that in the case of the stem of *Zamia* the power of regeneration is present in all meristematic tissue; in cases of mutilation the tissue chiefly concerned is the phellogen of the callus, that over the region of the central cylinder being more often successful than that over the cortex.

Anatomy of Palm Roots.*—E. Drabble gives an account of his researches on the anatomy of the roots of palms. More than sixty species have been examined, and essentially similar results have been obtained from each. The adventitious root has its origin in the pericycle of the stem, arising as an extensive rhizogenic arc. The apex is occupied by a non-stratified group of initial cells, which give rise by division to a common ground-mass of parenchyma wherein, in very young roots, appears a series of separate procambial strands. These are continued, by secondary divisions of the parenchyma, into the central cylinder of the stem. The strands, usually after undergoing repeated bifurcations, are connected with the bundles of the stem. Each of these strands gives rise to a "stele"-like structure with exarch protoxylem-groups alternating with phloem-groups; but without histologically differentiated endodermis. As the root lengthens the procambial tissue takes the form of a series of arcs by apical fusion of the strands. Still later a lobed cylinder is produced, and finally the root-cylinder of a monocotyledonous plant results.

As a rule all the changes take place during the passage of the root through the thick cortex at the base of the stem, but in several species the lobed cylinder, or even the free strands, persist in the extra-cauline portion. The internally directed protoxylem-groups usually die out distally, but are occasionally represented by inversely orientated groups, the metaxylem elements persisting as the large scattered vessels nearly always present in palm-roots. The "medullary" strands are shown to be in reality the reduced remains of some of the free basal "stele"-like structures which have not entered into the composition of the vascular ring. In some few cases, the proximally free strands unite to form not a single cylinder, but three or more, so producing Cormack's "polystelic" condition. Distally these become incomplete on the central surface, and give rise by lateral fusion in the apical region to first a lobed, and finally a normal root cylinder.

The author regards the "medulla" in palm-roots as merely that por-

* Trans. Linn. Soc., ser. 2 (Bot.) vi. pp. 427–90 (4 pls. and figs. in text).

tion of the common ground-parenchyma, arising at the non-stratified apex, which becomes enclosed distally by fusion of the procambial strands, and hence differs in no respect from the external "cortical" parenchyma. The suggestion is put forward that all ideas of "monostely" and "polystely," and of "medulla" and "cortex" as separate morphological entities, are based on an artificial conception of the structures involved.

Anatomy of Anemiopsis californica.*—T. Holm gives an account of the anatomy of the vegetative organs of this plant—a member of the tribe Saurureæ of the order Piperaceæ—included by Bentham and Hooker in *Houttuynia*, but considered as a distinct genus by Eichler, De Candolle, and others. The plant lives in moist, saline localities, and may perhaps be regarded as a halophyte. The author considers, however, that its structure may be defined more properly as simply piperaceous than either halophilous or xerophilous. The most conspicuous characters—the prominently developed hypoderm and the abundance of secreting cells throughout the various tissues—are in conformity with the general structure of the order rather than with halophytes. There are also points of difference in the anatomy of the leaves, petiole and stem. It would appear as if *Anemiopsis*, so far as concerns its structure, gives a better illustration of one of the several types of the Piperaceæ than of any specialised type modified in accordance with the environment.

Stomata of Holacantha.†—C. E. Bessey describes the stomatal apparatus of the burro thorn (*Holacantha Emoryi*), a leafless, thorny shrub about 3 metres high (or sometimes arborescent), which forms impenetrable thickets in the deserts of the Southern States. It is a member of the Simarubeæ. The surface of the branches and thorns (or modified branches) is pea-green in colour. The epidermis is 3–5 layers deep, with a remarkably thick outer wall and much thickened lateral walls. Below the epidermis is a thick mass of palisade cells. The stomata are thickly scattered over the surface, numbering about 73 per sq. mm. Each lies at the bottom of a narrow chimney-shaped cavity, which passes entirely through the thickness of the epidermis and is prolonged both above and below it; the cavity is of a somewhat smaller diameter at the mouth. The stomal apparatus at the lower end of the chimney consists of from 40–60 cells, which extend down into the mass of palisade tissue. It is almost circular in cross section, and consists of from 10–12 rows of thinner-walled cells than those forming the main part of the chimney. At the bottom of this structure is the proper stoma, which closely resembles that of ordinary plants, and beneath it is the usual air-cavity. The whole forms a successful means for protecting the plant against loss of water while allowing free access of carbon-dioxide. The highly transparent epidermis permits photosynthesis.

Reproductive.

Pro-embryo of the Bennettiteæ.‡—G. R. Wieland describes pro-embryos which he has seen in fruits of *Cycadeoidea* from the Black Hills.

* Amer. Journ. Sci., ser. 4, xix. (1905) pp. 76–82 (fig. in text).
† Bull. Torrey Bot. Club, xxxi. (1904) pp. 523–7.
‡ Amer. Journ. Sci., ser. 4, xviii. (1904) pp. 445–7 (1 pl.).

In a specimen which bears a number of fine ovulate cells, with seed-bodies approximately the same size as in the original *Bennettites Gibsonianus*, the author found large angular to rounded pro-embryonal cells. These appear to fill the entire nucellar space in some of the transverse sections. In others the pro-embryo cells appear to have been but partially preserved or else to have collapsed, carrying the nucellar wall inwards, as if there had been a central cavity in the large-celled mass; several irregular ribbon-like traces were also noted, about the thickness of the cell-walls, extending across the large-celled mass. These are not supposed to be suspensors, or tubular oospores or cells, such as precede embryo-formation in *Ephedra*. Some sections suggest that the mass of pro-embryo tissue was either less dense in its central regions or that there was a small central cavity, but this point, which would show a fundamental agreement with existing Cycads, cannot be readily settled in absence of a good longitudinal section. It is evident, however, that the lower half of the nucellus was closely filled by the typical large undifferentiated cells making up the mass of the pro-embryo. Another section showed the upper end of the nucellus extending well into the top of the seed, which is quite filled with the characteristic tissue.

There is no distinct indication of endosperm, or of differentiation into an inner and outer zone. The pro-embryo tissue appears to be homogeneous throughout, except in one instance, where some more elongated cells appear to rest against the nucellar wall.

Comparison with the other gymnosperms shows that the pro-embryo of the Bennettiteæ is unique in occupying the entire nucellus, though it must be borne in mind that the nucellæ of the existing Cycads are almost of the same size, increase in the size of the seed having been plainly bound up with endosperm development. It may be that a progressive reduction of endosperm has taken place in the Bennettiteæ, and was perhaps a cause of the disappearance of the group. The pro-embryo shows most resemblance to that of *Ginkgo*, and proves that the embryogeny of *Ginkgo* is the most primitive among existing gymnosperms.

Life History of Pinus.*—Margaret C. Ferguson gives a detailed account of the results of her work on this subject, derived mainly from a study of *Pinus Strobus*. The subject-matter falls under the headings: microsporogenesis, the male gametophyte, macrosporogenesis, the female gametophyte, and fertilisation and related phenomena. In most species the archesporium is well developed before winter, but the mother-cell stage is not reached till the next April, or in *P. Strobus* till May. There is probably a qualitative reduction of chromatin during the second mitosis in the pollen-mother-cell. The air sacs arise by the separation of the exine from the intine at two definite points. The author describes a feature hitherto overlooked, a partial wall lying within the intine at the prothallial end of the spore. The generative cell is not surrounded by a definite wall, and when its nucleus divides the two

* Proc. Washington Acad. Sci., vi. (1904) pp. 1–202 (24 pls.). See also Chamberlain in Bot. Gazette, xxxix. (1905) pp. 66–7.

sperm-nuclei lie free in a common mass of cytoplasm and never form distinct sperm-cells; the two nuclei are unequal. The endosperm contains about two thousand free nuclei before walls begin to be formed. The archegonia appear about two weeks before fertilisation. He also describes in considerable detail the independence of the male and female chromatin during fertilisation. Eight nuclei are formed in the proembryo at the base of the oosphere before the appearance of cell-walls.

Comparative Embryology of the Cucurbitaceæ.*—J. E. Kirkwood gives the results of his work based on the study of sixteen genera of this order, and relating chiefly to the development of the ovary and embryo-sac. Some light is thrown on the systematic position of the family which has been placed in recent Continental systems among the Sympetalæ, owing chiefly to the union of the petals. The author of the present memoir, however, finds that in all the sixteen genera certain characters of Sympetalæ which have been regarded as fundamental are contradicted. For instance, the ovule in the Sympetalæ is constantly characterised by a single very prominent integument, a much reduced nucellus, and the elimination of tapetal tissue, the hypodermal archesporial cell passing over directly into the mother-cell. But in all the Cucurbitaceæ studied, the author finds the ovules with two integuments, a well-developed nucellus, and often very extensive tapetal tissue. The synergids are remarkable for their prominence and structure, and the antipodals are ephemeral; the endosperm is characterised by extensive growth and nutritive activity.

Physiology.

Nutrition and Growth.

Carbon Nutrition of Green Plants by Organic Substances.†—J. Laurent gives a full account of his experiments on this subject. He finds conclusive evidence of the value of carbohydrate foodstuffs to green plants when presented to their roots. Thus maize roots were able to make use of glucose solutions, the plants showing increase of dry weight when grown in the dark; and plants of various species, previously deprived of starch, were able to manufacture starch in sunlight when glucose, in 1–5 per cent. solutions, was presented to their roots, under conditions which ensured absence of carbon dioxide. The author, however, failed to induce roots of green plants to digest starch, indicating a fundamental difference between the nutrition of saprophytes, which have this power, and autophytes. In a series of experiments on the influence of organic substances on growth and form, the author found that growth of the stem was checked in concentrated solutions. That this result does not entirely depend on increased osmotic pressure is shown by the fact that different results are obtained with solutions of equal concentration of glucose and glycerin respectively.

* Bull. New York Bot. Garden, iii. (1904) pp. 313–402 (12 pls.). See also J.M.C. in Bot. Gazette, xxxix. (1905) p. 73.

† Rev. Gen. Bot., xvi. (1904) pp. 14–48, 66–80, 96–128, 155–66, 188–202, 231–42 (7 pls.).

Relative Transpiration of Old and New Leaves of the Myrtus Type.*—J. Y. Bergen has studied the relative activity in transpiration of old and new leaves in some leathery-leaved evergreens of the Neapolitan region, such as olive, holm-oak, *Rhamnus Alaternus* and *Nerium Oleander*. He finds that the evergreen trees and shrubs of this region differ greatly in the longevity of their leaves, some of the species having leaves that live only about fifteen months, while those of others live more than two-and-a-half years. All of the leaves studied reach their maximum area considerably before they attain their full thickness. The leaves of six of the eight species studied transpire more for equal areas when fifteen to eighteen months old than they do when they have just reached their maximum area, at three or four months. Transpiration for equal weights of leaves is generally more active for leaves of fifteen or more months than for those of three months or a little older. Epidermal transpiration bears a much smaller ratio to total transpiration in leaves of three months than in those of fifteen months.

Daily Periodicity of Cell-division and of Elongation in the Root of Allium.†—W. E. Kellicott finds in the root of *Allium* two maxima and two minima in the rate of cell-division during twenty-four hours. The primary maximum occurs shortly before midnight, the primary minimum about 7 a.m. The secondary maximum occurs about 1 p.m. and the secondary minimum about 3 p.m. There is no correspondence between the rate of cell-division and slight variations in temperature. The root of *Podophyllum* shows maximal and minimal points at almost the same hours as in *Allium*. Tap-water alone, or with various substances in solution, seriously affects the course of cell-division. In some cases there may be recovery and partial return to the normal condition. Under normal conditions of growth the rate of elongation of the root of *Allium* shows a daily rhythm, with two maxima and two minima during twenty-four hours. Elongation is most rapid about 4 or 5 p.m., the secondary maximum occurring about 7 a.m.; the primary minimum is about 11 p.m., and the secondary minimum about noon. Periods of rapid cell-division coincide with low rate of elongation, and rate of cell-division is lowest during rapid elongation.

Periodicity of Growth in Thickness in the Tropics.‡—A. Ursprung has studied the structure of the wood of some species growing at Buitenzorg, where the climate is uniform, and in Eastern Java, where there is an alternation of wet and dry seasons. He finds in the latter a much more striking development of the annual ring structure than in the case of the same species grown at Buitenzorg, though there is some variability in the relative differences in different species. Representatives of six natural orders were examined.

Chemical Changes.

Blackening of Baptisia tinctoria.§—J. T. Emerson discusses the blackening of Wild Indigo on Cape Cod. If a leaf is injured a black

* Bot. Gazette, xxxviii. (1904) pp. 446–51.
† Bull. Torrey Bot. Club, xxxi. (1904) pp. 529–50.
‡ Bot. Zeit., lxii. (1904) pp. 189–210.
§ Bull. Torrey Bot. Club, xxxi. (1904) pp. 621–9.

spot appears, and branches which have been injured are the first to show the blackening, which, however, appears naturally in uninjured plants, affecting even the flowers. The author finds that the blackening is due to oxidizing enzymes, of which there are at least two, an oxidase which gives an opalescent blue with gum guaiac solution, and is destroyed by heat at about 83°–84° C., and a peroxidase which give a deep blue with hydrogen peroxide, and which is destroyed by heat at 86°–87° C. Both enzymes can be destroyed with dilute solutions of citric acid and sodium hydroxide.

General.

Identification of Trees in Winter.*—L. H. Scholl, E. C. Cotton, and J. H. Schaffner have prepared keys to the hickories, ashes, and poplars respectively, in the winter condition as regards Ohio species. The characters used are the form, colour and indumentum of the bud, the character of the bud-scales, and the surface characters of the twig, and, in case of hickory, of the bark. There are six species of hickory, seven of ash, and eight of poplar.

Localised Stages in Common Roadside Plants.†—J. A. Cushman describes for a number of common North-American species the various progressive stages towards the adult leaf-form which characterise the seedling, and in the case of perennials, the spring growth, and also the regressive development which occurs on flowering shoots. The species studied include *Thalictrum polygamum*, Wild Carrot, Wild Indigo (*Baptisia tinctoria*), Sheep Sorrel, *Potentilla canadensis*, *Sambucus canadensis*, *Chenopodium album*, Yarrow, and species of *Aster* and *Eupatorium*. In *Thalictrum* and *Baptisia*, the chief feature is a change in the number of leaflets ; in *Rumex*, a change in the auricled leaf-base ; in *Eupatorium*, the presence or absence of the connate leaf-base. Different individuals show variations due to differences in acceleration of development, which may be due to external or internal causes. Regressive development, seen in localised senescence below the flower, is often more reversionary than stages in the usual seedling.

Variation of California Plants.‡—E. B. Copeland points out that, while one of the first features of the flora of the mountainous and rather dry parts of California which impresses any one familiar with that of the Eastern States and the Mississippi Valley, is the exceeding variability of a great many of the plants, it has yet never been the subject of any particular study. He describes the variation in the leaf-characters—size, margin, base and apex—in a few woody plants comprising several oaks, *Rhamnus californica*, *Arctostaphylus tomentosa*, and species of *Ceanothus* and *Baccharis*. The leaf-variation in a few apparently monstrous ferns is also described. The author then uses his results as a basis for a discussion of the mutation theory in bionomics ; and endeavours to show that there is no foundation for the view that mutations exist as essentially distinct from ordinary variations.

* Ohio Nat., v. (1905) pp. 269–71.
† Amer. Nat., xxxviii, (1904) pp. 818–32 (figs. in text).
‡ Bot. Gazette, xxxviii. (1904) pp. 401–26.

Relation of Soils to Vegetation.*—B. E. Livingston has studied the relation of soils to natural vegetation in Roscommon and Crawford Counties, Michigan. He finds that the main factor in determining the distribution of the forests on the uplands of this region is that of the size of soil particles, the sorting of which dates back almost entirely to the close of the last Glacial epoch. The size of the particles determines the amount of air and moisture in the soil, and these in turn determine the amount of humus formation and the growth of nitrifying organisms, and perhaps also to some extent the amount of soluble salts in the surface layers. A factor of less importance, because applicable only over small areas, is the nearness of the underground water level to the surface. Broadly speaking, physiography determines the vegetational distribution. The physiographic features are largely those of glacial topography, or traceable directly to these. It is probable that many dry soils have at length become moist enough to support one of the more moisture-loving types of vegetation simply by increase of humus content. The lowlands are covered with a vegetation complex of species such that they can bear excess of water and paucity of oxygen in the soil. From the open meadow and coniferous swamp we pass, with better and better drainage, through the mixed swamp to the hardwood, or the white pine of the uplands. The natural re-forestation of the pine areas with Norway pine, and partly, at least, with white pine, will probably occur if the fires can be suppressed.

Asiatic Plants.†—D. Prain has published notes on various Indian and East Asiatic plants. These include a new genus of Araliaceæ (*Woodburnia*) from Burma, described as a striking plant with flowers unusually large for the family; a new *Musa*, from Assam, a fine species, which in habit much resembles a Sikkim variety of the common *Musa paradisiaca*, and several new Convolvulaceæ from China and Malaya. The author also gives some critical notes on the Roxburghiaceæ, with a key to the species of *Stemona*.

Flora of the Australian Alps.‡—J. Stirling has studied the flora of this area with a view to ascertain the origin and distribution of the mixed types of plants now flourishing on the higher altitudes over South-East Australia, and its relation to the tertiary floras of South-East Australia. The author has collected more than 1000 species in the region at elevations between 2000 and 7000 feet, and the present is a preliminary account, with a census of the plants. The general study of the flora shows that climatic conditions have had a dominating influence in the evolution of varietal forms. This is especially noticeable in the genus *Eucalyptus*.

The author gives an account of the physical features of the range. All the higher plateaux are distinctly Alpine; the soil is rich, volcanic, and highly productive. Fine Eucalyptus forests clothe the sub-Alpine levels. The plants comprise 249 genera, with 678 species of Seed-plants; and 161 genera, with 341 species of Cryptogams.

* Bot. Gazette, xxxix. (1905) pp. 22–41.
† Journ. Asiat. Soc. Bengal, lxxiii. (1904) pp. 14–24 and 39–46 (1 pl.).
‡ Trans. and Proc. Bot. Soc. Edinburgh, xxii. (1904) pp. 319–95 (3 pls.).

The best represented orders are Leguminosæ, with 22 genera and 76 species; Compositæ, with 25 and 74; and Grasses, with 19 and 35. There is a greater affinity with the Tasmanian Alpine flora than with that of any other region. Notes are given on the more interesting plants in the different natural orders, and also a census of all the plants known, including Cryptogams.

Fries, Th. M.—Svenska Växtnamn. (Swedish plant-names.)
[An annotated list of popular names of plants, with their Latin equivalents. References to literature are given.]
Arkiv f. Botanik, iii. No. 13 (1904) pp. 23–60.

Malme, G. O.—Die Umbelliferen der zweiten Regnell'schen Reise. (The Umbelliferæ of the second Regnell expedition.)
[A systematic account of the plants of this order collected on this Brazilian expedition. The family is represented in Brazil chiefly by the genera *Hydrocotyle* and *Eryngium*, which include 6 and 20 respectively of the 31 species collected. Four new species and two new varieties of *Eryngium* are described.]
Tom. cit. pp. 1–22 (3 pls.).

Merino, B. P.—Contribución á la Flora de Galicia. Supplement IV. [Fourth supplement to the Flora of Galicia.)
[A systematic list of ferns and seed-plants, with critical notes and descriptions of new species of *Erica*, *Linaria*, and *Sagina* respectively.]
Mem. d. l. Soc. Españ. Hist. Nat., ii. (1904) pp. 455–516.

Townsend, F.—Flora of Hampshire, including the Isle of Wight.
[New edition, with numerous additions.]
Lovell Reeve (1904) xxxviii. and 658 pp., 2 pls. and map.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Anatomy of Psilotum triquetrum.*—S. O. Ford gives a detailed account of the anatomy of this plant. It consists of a much-branched aerial stem and rhizome. The leaves are much reduced, and have no vascular supply. There are no roots. The plant is monostelic throughout. At the base of the aerial stem a protostele is found, and this, higher up, may be succeeded by a medullated stage with no inner phloem or endodermis. Secondary tracheids may occur. In the aerial branches a central core of sclerenchymatous fibres is found, surrounded by xylem with radiating groups of protoxylem. In the rhizome the xylem forms an irregular mass with no fibres, and the protoxylem consists of ordinary scalariform tracheids. The phloem throughout is feebly developed, and lignification of this tissue may occur in the aerial stem. A three-sided apical cell is present both in the aerial stem and in the rhizome. From the nature of the sporangial apparatus the Psilotaceæ have been regarded as possessing a close affinity with the fossil Sphenophyllales. There is also a strong resemblance, anatomically, to some of the fossil Lycopods, especially to the stem of *Lepidodrendron mundum*, as well as to the axis of the cone of *Lepidostrobus Brownii*.

* Ann. Bot., xviii. (1904) pp. 589–605 (1 pl.).

Prothallium of Ophioglossum vulgatum.*—H. Bruchmann has succeeded in finding the long-sought gametophyte of *O. vulgatum*, and describes in detail and with many figures the external and internal structure of the prothallium and young sporophyte. The prothallium shows a radial structure, and agrees in the main with that of *O. pedunculosum* and *O. pendulum*. It yet remains to cultivate the spores, so that the earliest stages of the prothallium may be obtained. Incidentally he describes the cutting of a lenticular cell (first rhizoid cell) from the basal cell of the infant prothallium in several European species of *Lycopodium*.

Polystichum.†—A. Somerville treats of the three British species of this genus:—*P. Lonchitis*, *P. aculeatum*, *P. angulare*, with special reference to this last, the distribution of which in Scotland (where it is becoming increasingly rare) he describes. *P. lobatum* he suppresses, stating his reasons for regarding it as an immature form of *P. aculeatum*. He indicates several points of distinction between *P. aculeatum* and *P. angulare*.

BATTANDIER ET TRABUT—**Flore Analytique et Synoptique de l'Algérie et de la Tunisie.** (Analytic and synoptic flora of Algeria and Tunis.)
[Contains on pp. 401–8 the Pteridophyta, with descriptions and keys.]
Paris: Klincksieck (1904) 460 pp.

BERNSTIEL, O.—**Scolopendrium officinarum f. undulatum.**
Gartenwelt, ix. (1904) pp. 121–2.

BOODLE, L. A.—**The structure of the leaves of the Bracken (Pteris Aquilina Linn.) in relation to environment.** *Journ. Linn. Soc.* (*Bot.*) xxxv. (1904) pp. 659–70.

BOUYGUES—**Sur l'interprétation anatomique des cordons libéraux ligneux du Pteris Aquilina.** (On the anatomical interpretation of the wood-bast fibres of *P. Aquilina.*)
Act. Soc. Linn. Bordeaux, lviii. (1903) p. 76.

BRAIM, J.—**Osmunda regalis at Goathland.** *Naturalist*, 1904, p. 378.

BRENZINGER, C.—**Flora des Amtsbezirks Buchen.** (Flora of the district of Buchen.)
Mitt. Bad. Bot. Ver., 1904, p. 385–416.

CAMPBELL, D. H.—**The Affinities of the Ophioglossaceæ and Marsiliaceæ.**
Amer. Naturalist, xxxviii. (1904) pp. 761–75 (figs. in text).

CHIFFLOT, J.—**Sur un cas rare d'hétérotaxie de l'épi diodangifère de l'Equisetum maximum Lam. et sur les causes de sa production.** (On a rare case of heterotaxy of the diodangiferous spike of *E. maximum* and the causes of its production.)
Note prés. à la Soc. Linn. Lyon, 1904, 5 pp.:
Hedwigia, xliv. (1905) Beibl., p. 82.

CHRIST, H.—**Primitiæ Floræ Costaricensis. Filices et Lycopodiaceæ.** (First-fruits of the flora of Costa Rica. Ferns and Lycopodiaceæ.)
[Continuation.] *Bull. Herb. Boiss.*, v. (1905) pp. 1–16.

„ „ **Quelques remarques concernant une collection de Fougères du Bhotan récoltées par W. Griffith et acquise par l'Herbier Delessert en 1856.** (Some remarks upon a collection of ferns of Bhotan collected by Griffith and acquired by Herbier Delessert in 1856.)
Ann. Conserv. Jard. bot. Genève, vii.–viii. (1904) pp. 330–32.

CLUTE, W. N.—**Adiantum Capillus-veneris in Pennsylvania?**
[A plea for investigation of reported occurrences of the species.]
Fern Bulletin, xii. (1904) pp. 121–2.

* Bot. Zeit., lxii. (1904) pp. 227–48 (2 pls.).
† Trans. Proc. Bot. Soc. Edinburgh, xxii. (1904) pp. 312–17.

CLUTE, W. N.—**The Jamaica Walking Fern.**
[*Fadyenia prolifera.*] *Tom. cit.*, pp. 112–3 (1 pl.).

COOKE, R. S.—**Notes from Louisiana.**
[On *Azolla caroliniana*, *Adiantum pedatum*, and *A. Capillus-veneris.*]
Tom. cit., pp. 110–1.

DUKES, W. C.—**Babyhood of Ferns.**
[Method of cultivating prothallia.] *Tom. cit.*, pp. 105–6.

" " **Fall-fruiting of Osmunda.** *Tom. cit.*, pp. 103–4.

EATON, A. A.—**Dodge's Fern.** *Amer. Botanist*, v. (1904) p. 117.

" " **Pellæa ornithopus.** *Fern Bulletin*, xii. (1904) pp. 113–4.

FITZPATRICK, T. J.—**Notes on the Ferns of Washington.**
[A list of 13 species, with notes.] *Tom. cit.*, pp. 108–10.

" " **The Fern Flora of Montana.**
[A list of 39 species, with notes.] *Tom. cit.*, pp. 97–101.

FLEMING, W. W.—**Abnormal Growth of Polypody.**
[Fronds of *P. vulgare* as long as 2 ft. 3½ in. were found on a wall near Portlaw.]
Irish Naturalist, xiv. (1905) p. 40.

FOSTER, A. S.—**The Broad Wood Fern in Washington.**
[Note on the large size attained by *Nephrodium spinulosum dilatatum* on the west coast of America.] *Fern Bulletin*, xii. (1904) pp. 104–5.

FUTÓ, M.—**Polypodium vulgare L. und Polypodium vulgare, γ serratum Willd.**
[Claims specific rank for the latter.]
Hedwigia, xliv. (1905) pp. 106–11 (1 pl.).

GODRON—**Remarques sur le Polystichum oreopteris.** (Remarks on *P. oreopteris.*)
Bull. Soc. Amis Sci. Nat. Rouen, 1904, pp. 4–7.

HAHNE, A. H.—**Forking Ferns.**
[A list of 79 species, with notes to show the position, kind and degree of bifurcation in each case.] *Fern Bulletin*, xii. (1904) pp. 114–8.

HARRISON, C.—**Sligo Ferns.**
[Records the finding of *Hymenophyllum unilaterale*, *H. tunbridgense*, and *Polypodium vulgare* var. *cambricum*. In an editorial note R. L. Praeger remarks on the extreme rarity of the latter in Ireland, and points out that Linnæus considered it a good species.]
Irish Naturalist, xiv. (1905) pp. 39, 40.

HIERONYMUS, G.—**Plantæ Lehmannianæ in Guatemala, Columbia et Ecuador regionibusque finitimis collectæ. Pteridophyta.** (Plants collected by Lehmann in Guatemala, Columbia, Ecuador, and the neighbouring regions. Pteridophytes.]
[*Ceratopteris* to *Selaginella*. Conclusion.]
Engler's Bot. Jahrb., xxxiv. (1905) pp. 561–82.

" " **Polypodiorum species novæ et non satis novæ.** (Species of *Polypodium* new or insufficiently known.)
[Descriptions of new species and remarks on older species. Keys to the *P. serrulatum* and *P. trichomanoides* groups.]
Hedwigia, xliv. (1905) pp. 78–105.

HOCHREUTINER, B. P. G.—**Cryptogames vasculaires.** (Vascular cryptogams.)
[In his "Le Sud Oranais."] *Ann. Conserv. Jard. Bot., Genève*, 1904, pp. 112–3.

KELLERMAN, W. A., & H. A. GLEASON—**Notes on the Ohio Ferns.**
[A localised list of 45 species; 10 others require authentication.]
Ohio Naturalist, iv. (1904) pp. 205–10.

KÜMMERLE, J. B.—**Adatok a Kaukasus edényes virágtalan növényeinek ismeretéhez.** (Contributions to a knowledge of the Pteridophyta of the Caucasus.)
Annal. Mus. Nation. Hungaric., ii. (1904) pp. 570–3.

P 2

LE GRAND, A.—**Distribution géographique des Asplenium fontanum et foresiacum.** (Geographical distribution of *A. fontanum* and *foresiacum*.)
[The former species is exclusively calcicolous, while *A. foresiacum* Le Grand (syn. *A. Halleri* var. *macrophyllum* Saint-Lager) is absolutely silicicolous, and occurs in the centre and south of France.]
Rev. Bot. Syst. et Geogr., 1904, pp. 103–9.

MAXON, W. R.—**A new Asplenium from Mexico.**
[Description of *A. modestum*, with indication of its affinities.]
Bull. Torrey Bot. Club, xxxi. (1904) pp. 657–8.

„ „ **A new Fern, Goniophlebium Pringlei, from Mexico.**
Proc. U.S. Nat. Mus., xxvii. (1904) pp. 953–4.

„ „ **Notes on American Ferns. VII.**
[On the synonymy of the N.W. American *Polypodium occidentale* Maxon, and on *Asplenium pycnocarpon* Spreng.]
Fern Bulletin, xii. (1904) pp. 101–3.

NICHOLSON, W. A.—**Fauna and Flora of Norfolk. Part VI.** [additions].
[Flowering plants and ferns.] *Trans. Norfolk and Norwich Nat. Soc.*, 1903–4 (1904) pp. 748–51.

OSBORN, A.—**Aspidium anomalum.** *Garden*, lxv. (1904), No. 1689.

PHELPS, O. P.—**New Stations for two rare Connecticut Ferns.**
[*Pellæa gracilis* and *Asplenium montanum*.]
Fern Bulletin, xii. (1904) p. 118.

PODPĚRA, J.—**Weitere Beiträge zur Phanerogamen- und Gefässkryptogamen-flora Böhmens.** (Further contributions to the phanerogamic and vascular cryptogamic flora of Bohemia.) *Verh. K.K. Zool. Bot. Ges. Wien*, liv. (1904) pp. 313–41.

POTONIÉ, H.—**Die Zusatzfiedern (Aphlebien) der Farne.** (The additional pinnæ [Aphlebia] of ferns.) *Naturw. Wochenschr.*, 1903, pp. 33–41.

„ „ **Ueber die physiologische Bedeutung der Aphlebien.** (On the physiological meaning of the Alphlebia.)
Zeitschr. Deutsch. Geol. Ges., 1903, Monatsb. p. 11–12.

RITZBERGER, E.—**Prodomus einer Flora von Oberoesterreich.** (Preliminary essay of a flora of Upper Austria.) *Jahresb. Ver. Naturk. in Oesterr. ob. der Enns. Linz.*, 1904, 59 pp.

ROBINSON, C. B.—**The Ferns of Northern Cape Breton.**
Torreya, iv. (1904) pp. 136–8.

SALLET—**Les Hydroptéridées dans la région tonkinoise.** (The Hydropterideæ in the Tonkin region.) *Act. Soc. Linn. Bordeaux*, lviii. (1903) p. 244.

SCHMIDT, R.—**Ueber Gabelungen bei Farnen.** (On dichotomy in ferns.)
SB. Nat. Gesell. Leipzig, 1903, pp. 1–4.

SCHNECK, J.—**Asplenium ruta-muraria on the towers of Milan Cathedral.**
Fern Bulletin, xii. (1904) pp. 118–9.

SCHUBE, T.—**Die Verbreitung der Gefässpflanzen in Schlesien.** (The distribution of the vascular cryptogams in Silesia.) Breslau (Nischkowsky) 1903.

STIRLING, J.—**Notes on a Census of the Flora of the Australian Alps.**
[Contains a list of plants, including 51 pteridophytes, with their distribution and altitude.] *Trans. Bot. Soc. Edinburgh*, xxii. (1904) p. 319.

TRAIL, J. W. H.—**Topographical Botany of the River-basins Forth and Tweed in Scotland.**
[With a list containing 48 pteridophytes.] *Tom. cit.*, pp. 277–308.

WAISBECKER, A.—**Ujadatok Vas vármegye flórájához.** (New contributions to the flora of the Eisenburg county in West Hungary.)
[Contains descriptions of 14 new forms of ferns.]
Mag. Bot. Lapok., iii. (1904) pp. 88–108.

WOOLSON, G. A.—**Nephrodium pittsfordensis.**
[The parentage of this hybrid.] *Fern Bulletin*, xii. (1904) pp. 106–8.

WORSLEY, A.—**Notes on some plants and ferns found about Petropolis (South Brazil), February and March 1900.** *Journ. R. Hort. Soc.*, xxviii. (1904) pp. 525–32.

YABE, Y., & K. YENDO—**Plants of Shimushu Island.**
Bot. Mag. Tokyo, xviii. (1904) p. 167.

Bryophyta.

(By A. GEPP.)

European Mosses.*—G. Roth publishes the eleventh and concluding part of his "Europäischen Laubmoose." The whole work forms two thick volumes, and contains upwards of 1300 pages of text, illustrated by 62 plates, on which are figured nearly 1250 species; and it has been published in the short space of a year and a half. It treats of the mosses of all Europe, and figures an authentic sample of each species, some hundreds of the species having never been figured previously. The descriptions are re-written uniformly from the author's point of view, the important characters being italicised, but there are no keys to genera or species, nor are the magnifications of the figures given. The work is fully indexed.

ANONYMOUS—**Sphaignes de l'Ain. Espèces ou variétés nouvelles.** (Sphagna of the Ain. Species or new varieties.) *Bull. Soc. Nat. Ain*, 1904, p. 33.

ARNELL—**Martinellia obliqua Arnell.**
[Description of a new species of hepatic.]
Rev. Bryolog., xxxii. (1905) pp. 1–2 (figs.).

BAUER, E.—**Musci Alegrenses. Enumeration de mousses et d'hépatiques récoltées par M. Ed. Martin Reineck et M. Josef Czermack en 1897–9 au Brésil.** (Mosses of Porto-Alegre. Enumeration of mosses and hepatics gathered by Reineck and Czermack in 1897–9 in Brazil.)
[List of 10 hepatics and 42 mosses; 4 species are new.]
Tom. cit., xxxii. (1905) p. 11.

BECQUEREL, P.—**Sur la germination des spores d'Atrichum undulatum et d'Hypnum velutinum, et sur la nutrition de leurs protonémas dans des milieux liquides stérilisés.** (On the germination of the spores of *Atrichum undulatum* and of *Hypnum velutinum*, and on the nutrition of their protenemas in sterilised liquid media.) *Comptes Rendus*, cxxxix. (1904) pp. 745–7.

BOYD, D. A.—**Notes on Mosses from West Kilbride, Ayrshire.**
[Two seaside species, *Tortula ruraliformis*, with a note on the characters that distinguish it from *T. ruralis*; and *Brachythecium albicans*, fruiting abundantly.] *Trans. Edinb. Nat. and Micr. Soc.*, v. (1904) pp. 96–7.

BRITTON, E. G.—**Notes on Nomenclature. IV. The genus Neckera Hedw.**
[The history of this genus is given; and for stated reasons the name is changed to *Rhystophyllum*, and seven North American species are re-named accordingly.] *Bryologist*, viii. (1905) pp. 4–6.

CARDOT, J.—**Enumeration des Mousses récoltées par M. Hochreutiner en Algérie.** (List of the mosses collected by M. Hochreutiner in Algeria.)
[In B. P. G. Hochreutiner's "Le Sud Oranais."]
Ann. Conserv. Jard. bot. Genève, 1904, pp. 239–41.

CARDOT, J., & I. THÉRIOT—**New or unrecorded Mosses of North America.**
[Adapted from *Bot. Gazette*, May 1904.] *Bryologist*, viii. (1905) pp. 8-11.

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* Leipzig: Engelmann, 1905, Heft xi., pp. xvi., 641–733, pls. li.–lxii.

CLAASSEN, E.—**List of the Mosses of Cuyahoga and other counties of Northern Ohio.**
[Contains about 185 species, three of which are new to Ohio State.]
Ohio Naturalist, iv. (1904) pp. 157–60.

CORNET, A.—**Trois Mousses nouvelles pour la Flore Belge.** (Three mosses new to the Belgian flora. *Bull. Soc. Roy. Bot. Belg.*, xli. (1904) pp. 143–4.

DISMIER, G.—**Trichodon cylindricus Schpr. et Campylopus subulatus Schpr. dans les Vosges. Muscinées rares ou peu connues pour cette chaîne de montagnes.** (*T. cylindricus* and *C. subulatus* in the Vosges, with some Muscineæ rare or little known for this mountain chain.)
[Notes on six mosses and four hepatics.]
Rev. Bryolog., xxxii. (1905) pp. 8–10.

GROUT, A. J.—**Spore distribution in Buxbaumia.**
[An observation which shows that the peristome of *Buxbaumia aphylla* is not a useless organ, but plays a part in spore distribution.]
Bryologist, viii. (1905) pp. 3–4.

GYÖRFFY, J.—**Ueber das Vorkommen der Buxbaumia Hall. in Ungarn.** (On the occurrence of *Buxbaumia* in Hungary.)
[Enumeration of all recorded Hungarian localities for *Buxbaumia*; it is remarkable that *B. indusiata* is more frequent than *B. aphylla*, especially in the Tatra.] *Mag. Bot. Lapok.*, iii. (1904) pp. 250–4.

HAGEN, J., ET P. PORSILD.—**Descriptions de quelques espèces nouvelles de Bryacées récoltées sur l'île de Disko.** (Descriptions of some new species of *Bryaceæ* collected on Disco Island.) *Medd. om Grönland*, xxvi. (1904) pp. 435–65 (6 pls.).

HALIN, M.—**Découverte du Brentelia arcuata Schimp. en Belgique.** (Discovery of *B. arcuata* in Belgium.) *Bull. Soc. Roy. Bot. Belg.*, xli. (1904) pp. 188–9.

HARRIS, C. W. & W. P.—**Lichens and Mosses of Montana.**
Bull. Univ. Mont. Biol., ser. 1 (1904) pp. 303–31 (7 pls.).

HERZOG, T.—**Die Laubmoose Badens; eine bryogeographische Skizze.** (Bryogeographic sketch of the mosses of Baden.)
[Continuation. *Mnium* to *Polytrichum*.] *Bull. Herb. Boiss.* v. (1905) pp. 149–64.

HINTZE, F., & C. KOHLHOFF—**Eine Wanderung durch ein interessantes Moosgebiet Hinterpommerns.** (A trip through an interesting moss district of inner Pomerania.) *Ver. bot. Vereins Prov. Brandenburg*, xlv. (1904) pp. 38–40.

HOLZINGER, J. M.—**Review of Dr. Warnstorf's paper on European Harpidia.**
Bryologist, viii. (1905) pp. 7–8.

INGHAM, W.—**Tortula lævipiliformis De Not.** (A new observation.)
[Young plants observed growing naturally in the rosette of brood-leaves, a fact not mentioned by Correns, who found the young plants growing on the protonema produced by detached brood-leaves when cultivated in nutrient fluid.]
Naturalist, 1904, p. 378.

" " **Riccia sorocarpa Bisch.**
[Fruiting specimens associated with *Fossombronia cristata* in a stubble-field at Langwith in December; *Riccia glauca* being found in a similar field at Strensall.] *Tom. cit.*, pp. 378–9.

" " **Jungermannia minuta Crantz.**
[Found with *Lepidozia trichoclados* C. Muell. on dead sticks in a wood on Strensall Common.] *Tom. cit.*, p. 379.

LANGERON, M.—**Remarques sur la présence du Trichocolea tomentella Dum. dans le Jura.** (Remarks on the presence of *T. tomentella* in the Jura.)
Arch. Flore Jurass., v. (1904) pp. 63–6.

LINGOT, F.—**Cueillettes bryologiques dans l'Ain.** (Gatherings of Mosses in Ain.)
Bull. Soc. Nat. Ain, 1904, pp. 29–32.

MANSION, A.—**Compte-rendu de l Excursion bryologique du 11 Octobre 1903, à Weert-Saint-Georges, Praeghe et Néthen.** (Account of the bryological excursion, Oct. 11, 1903, to Weert-Saint-Georges, Praeghe, and Néthen.)
[Gives lists of mosses and hepatics gathered at the various spots visited.] *Bull. Soc. Roy. Bot. Belg.*, xli. (1904) pp. 182–5.

„ „ **Les Muscinées du Limbourg.** (The Muscineæ of Limbourg.)
[List of 45 hepatics, 14 sphagna, 159 mosses.] *Tom. cit.*, pp. 145–57.

MANSION, A., & CH. SLADDEN—**Note sur deux hépatiques nouvelles pour la flor-belge: Riccia sorocarpa Bischoff et Fossombronia angulosa Raddi.** (Note on two hepatics new to the Belgian flora.)
[Descriptions of the two species quoted, with notes.] *Tom. cit.*, pp. 185–8.

„ „ „ **Quelques mots de Géo-bryologie.** (A few words on geo-bryology.)
[On the study of mosses in relation to their geographical distribution, the soil on which they grow, and such conditions of environment as altitude, moisture, light, etc.] *Tom. cit.*, pp. 180–2.

MATOUSCHEK, F.—**Bryologische Notizen aus Tirol, Vorarlberg und Liechtenstein.** (Bryological records from Tyrol, Vorarlberg, and Liechtenstein.)
[Localised lists of 79 hepatics, 13 sphagna, and 258 mosses, with 6 new vars. or forms, and 10 other additions to the district.] *Hedwigia*, xliv. (1904) pp. 19–45.

NEMEC, B.—**Indukce dorsiventrality u mechu.** (The induction of dorsiventrality in some mosses.) *Rospravy Böhm. Acad. Prag.* xiii. No. 15 (1904) 24 pp.

NICHOLSON, W. E.—**Supplemental notes on the Mosses of South-Western Switzerland.**
[List of 55 species, with notes.] *Rev. Bryologique*, xxxii. (1905) pp. 3–7.

PEARSON, W. H.—**Lejeunea microscopica Taylor.**
[Records the occurrence of this very rare hepatic in Skye, and its distribution as far as it is known.] *Journal of Botany*, xliii. (1904) p. 31.

PÉTERFI, M.—**Adatok Románia lombosmohflórájához.** (Contributions to the moss-flora of Roumania.) *Mag. Bot. Lapok*, iii. (1904) pp. 241–5.

„ „ **Astomum intermedium.**
[A proof that this species is identical with *A. multicapsulare*, and only represents a forma *biennis* of it.] *Növ. Közl.*, iii. (1904) pp. 21–4 (figs.).

„ „ **Hunyad megye lombosmohái.** (Mosses of the Hunyadi counties.) *Jahrb. Hunyadin Tört. es Rég. Társulat*, xiv. (1904) pp. 73–116.

PODPĚRA, J.—**Ein Beitrag zur Laubmoosflora Böhmens.** (Contributions to the moss-flora of Bohemia.) *Ver. K.K. Zool. bot. Gesell. Wien*, liv. (1904) pp. 507–15.

„ „ **Geranium lucidum L., nová na Moravě rostlina jevnosnubna.** (*Ger. luc.*, a new phanerogam for Moravia.)
[Also four mosses new to the province.] *Zeitschr. des mähr. Landesmus.*, iv. (1904) No. 2.

RÖLL, J.—**Beiträge zur Torfmoosflora des Cascadengebirges in Nord-Amerika.** (Contributions to the sphagnum-flora of the Cascade Mountains of N. America.) *Hedwigia*, xliv. (1904) pp. 46–9.

RUSSELL, J.—**Report of the Microscopical Section.**
[Contains a short account of the life-history of *Marchantia polymorpha* and *Funaria hygrometrica*.] *Trans. Edinb. Field Nat. Micr. Soc.*, v. (1904) pp. 141–3.

SCHIFFNER, V.—**Bryologische Fragmente.** (Bryological notes.)
[These are:—18. A hepatic new for Middle Europe (*Kantia sphagnicola*); 19. Remarks on *Riccia Hübeneriana* Lindb.; 20. *Marsupella badensis* Schiffn., new for Bohemia; 21. On the occurrence of *Haplomitrium Hookeri* N. ab E. in the Riesengebirge; 22. On *Scapania obliqua* Arnell and its discovery in Middle Europe.]
Oesterr. Bot. Zeitschr., lv. (1905) pp. 6–13.

„ „ **Ein Kapitel aus der Biologie der Lebermoose.** (A chapter from the biology of Liverworts.)
Festschr. z. Aschersons 70 *Geburtstag. Berlin*, 1904, pp. 118–28.

SMITH, A. M.—**William Starling Sullivant.**
[A biographical notice, with portrait, of the famous bryologist of the United States; born 1803, died 1873. *Bryologist*, viii. (1905) pp. 1–3.

STEPHANI, F.—**Hepaticarum species novæ.** X.–XI. (New species of hepatics. Parts X.–XI.)
[Contains two new genera, *Gollaniella* and *Massalongoa*, both from the N.W. Himalaya.)
Hedwigia, xliv. (1904–5) pp. 14–5, 72–5.

„ „ **Species hepaticarum.**
[Continuation. *Plagiochila*, descriptions of 32 species.]
Bull. Herb. Boiss., v. (1905) pp. 175–90.

„ „ **Ueber die geographische Verbreitung der Lebermoose.** (On the geographical distribution of the Liverworts.)
[Remarks on the incapacity of the hepaticæ for wide dispersal, and the conclusions to be drawn that many genera represented by numerous species of close-creeping plants, with entire or bifid leaves, are indigenous to Europe; while some twelve genera, which are each represented by only one to three species, immigrated into Europe in the remote past, and, being unfitted to survive a changed climate, etc., were almost exterminated.]
SB. Nat. Gesell. Leipzig, 1903, pp. 27–31.

STIRLING, J.—**Notes on a Census of the Flora of the Australian Alps.**
[Contains a list of plants, including 170 mosses.]
Trans. Proc. Bot. Soc. Edinburgh, xxii. (1904) pp. 319–95.

TIMM, R.—**Ueber Torfmoose.** (On sphagna.)
[General remarks on sphagna and their uses.]
Verh. Nat. Vereins Hamburg, xi. (1904) p. lxxvi.

TORKA, V.—**Aloina brevirostris (Hook et Grev.) Kindb.**
Zeitschr. Naturw. Deutsch. Ges. Posen, xi. (1904) Heft i.

„ „ **Neuentdeckte Moose in der Provinz Brandenburg.** (Mosses recently discovered in the Province of Brandenburg.)
[Two species.] *Allg. Bot. Zeitschr.*, 1904, pp. 184–5.

„ „ **Während des Ausflugs am 14 August, 1904, bei Krumfließ und Promno in der Nähe von Pudewitz beobachtete Moose und Algen.** (Mosses and algæ observed during the excursion of Aug. 14, 1904, at Krummfliess and Promno, in the vicinity of Pudewitz.)
Zeitschr. Naturw. Deutsch. Ges. Posen, xi. (1904) Heft i.

VAN DEN BROECK, H.—**Compte-rendu de la deuxième herborisation de la section de Bryologie, le 21 Mai, 1903, dans la Campine Anversoise.** (Account of the second field-day of the bryological section, on May 21, 1903, in the Antwerp plain.
[Gives a list of 46 mosses, 18 sphagna, and 20 hepatics.]
Bull. Soc. Roy. Bot. Belg., xli. (1904) pp. 165–70.

WARNSTORF, C.—**Die Laubmoose.** (The Mosses.)
Kryptog. fl. Mark Brandenburg, ii. 2 (1904) pp. 241–432 (figs.).

WATTS, W. W.—**Notes on some New South Wales Hepatics.**
[List of 23 species.] *Proc. Linn. Soc. New South Wales*, xxvii. (1903) pp. 493–4.

WATTS, W. W.—**Further Notes on Australian Hepatics.**
[List of 44 species.] *Op. cit.*, xxix. (1904) pp. 558–60.

WEST, W.—**Scapania aspera in West Yorkshire.**
[Frequent in every limestone district.] *Naturalist*, 1904, p. 379.

WHELDON, J. A.—**A gemmiparous Pterigynandrum.**
[Description of *P. filiforme* var. *montanense*, a new variety from south-west Switzerland, remarkable for its abundant gemmæ.]
New Bryolog., xxxii. (1905) pp. 7–8.

WILLIAMS, R. S.—**Bolivian Mosses. Part I.**
[Treats of Acrocarpi, *Andreæa* to *Funaria*, and contains descriptions of 3 new genera and 28 new species.] *Bull. New York Bot. Garden*, iii. (1903) pp. 104–34.

ZSCHACKE, H.—**Vorarbeiten zu einer Moosflora des Herzogtums Anhalt. I. Die Moose des Harzvorlandes.** (Preliminary studies for a mossflora of the Duchy of Anhalt. I. Mosses of the foot-hills of the Harz.)
Verh. bot. Vereins Prov. Brandenburg, xlv. (1904) pp. 1–37.

Thallophyta.

Algæ.

(By E. S. GEPP.)

Plankton of Three English Rivers.*—F. E. Fritsch continues his algological notes, and the subject of the sixth is a comparison of the plankton of the Cam, at Cambridge, the Trent, at Nottingham, and the Thames. Samples from the first two rivers were taken within a few days of each other in August of last year, and the Thames sample was taken two years previously. A table is given, illustrating the comparative constitution of the three rivers. As regards the number of different species in the Trent and the Thames, there is little to choose between the two; but from the point of view of number of individuals, the author finds that eight species occur commonly, or very commonly in the Thames, whereas in the Trent no species can be called common. The filamentous diatoms are important constituents in both Thames and Trent. A few species, *Volvox globator* and *Ceratium hirundinella*, were found in the Trent only. *Bacillaria paradoxa* occurs in the Trent, and in the Thames above Teddington, beyond tidal influence. As regards the Cam, the author likens it to a Thames backwater, from its sluggish stream. He finds that, as in backwaters, the quantity of individuals is much greater, although the number of different species (Cam 16, Thames 30, Trent 32) is markedly less than in a main river like the Thames or Trent. Diatoms are by far the most dominant forms in the Cam.

Phytoplankton of some Plön Lakes.†—E. Lemmermann continues his studies on the phytoplankton of these lakes. In the present study he treats of the Great Plön Lake, the Schluen Lake, the Plus Lake, and the small Uklei Lake. In the first he finds there are three periods: I. First *Bacillaria* period, in which *Melosira distans* var. *lævissima* Grun. occurs in masses from January to the end of April; *Diatoma elongatum* Ag. in May; *Asterionella gracillima* Heib. and *Anabæna*

* Ann. Bot., xix. (1905) pp. 163–7.
† Forsch. Ber. Biol. Stat. Plön., x. (1903) pp. 116–71.

Lemmermanni Richter, through June to the beginning of July; and *Fragilaria crotonensis* Kitton, during July. II. Schizophyceæ period. *Gloiotrichia echinulata* Richter, July to August; *Clathrocystis aeruginosa* Henfr., Oct. to Nov. III. Second *Bacillaria* period. *Melosira distans* var. *lævissima* Grun., December to January.

These species occur in masses during the periods stated. The author attributes the periodicity to change of temperature and to the varying quantity of silicic acid in the water. Details are given of the plankton of the other lakes. Several new varieties are described for species already known, as well as a new genus and species, *Botryodictyon elegans*. Changes of nomenclature are brought forward, and remarks are made on the free-swimming species of *Lyngbya* and the genus *Hyalobryon*, as well as various other species.

Studies on Phytoplankton.*—C. H. Ostenfeld publishes his second and third studies on this subject. The former is on a sample from a lake in South Iceland, collected by H. Jonsson. The main part of the sample consists of diatoms, among which *Diatoma hiemale* occurs in long bands like a *Fragilaria*, and is here recorded for the first time as a plankton form. Neither *Tabellaria* nor *Cyclotella* occur in the sample. A great quantity of *Tribonema bombycinum* Derb. et Sol. forma *depauperata* Wille, was found, but the other green algæ were few and only in single specimens. The author considers that the plankton of this lake is like that of the lowland lakes of Northern Central Europe and Southern Scandinavia, but much poorer, especially by the lack of the summer forms.

The latter of these studies deals with the phytoplankton from some tarns near Thorshavn (Strömö) in the Faeröes. This work is supplementary to the author's paper published with Professor Börgesen. The results are tabulated. Very few diatoms were obtained in four of the five tarns examined, but in the fifth they were predominant. *Peridinium Willei* was abundant.

Classification of Protophyta.†—C. E. Bessey publishes a revision of the families and a rearrangement of the North American genera. He divides the Schizophyceæ into two orders—Cystiphoræ and Nematogeneæ—the first being 1-celled, the second filamentous. Cystiphoræ consists of the Chroococcaceæ, and Nematogeneæ contains Oscillariaceæ, Rivulariaceæ, Scytonemaceæ, Nostocaceæ, Sirosiphoniaceæ. Keys are given to the genera in each family, and each genus is described.

Remarks on Glœocapsa.‡—G. T. West describes the life-history of *Glæocapsa crepidinum*, which occurs on mud, etc., in salt or brackish water. Seven stages in the life-history are figured in colours. The thick hyaline integument is not a gelatinised cell-wall, but is excreted by the cell. Multiplication takes place by simple cell-division. The daughter-cells secrete each their own integument, being still enclosed within the much stretched mother-cell integument. Thus colonies of two or four with lamellated integument are formed. Finally, the young

* Bot. Tidssk., xxvi. (1904) pp. 231–9.
† Trans. Amer. Micr. Soc., xxv. (1904) pp. 89–104.
‡ Trans ... Nat. and Micr. Soc., v. (1904) pp. 130–3 (1 pl.).

cells are liberated by the rupture of the primary integument, and each forms a new colony. At intervals a cell develops a spiny, cellulose coat outside the integument, and becomes a resting-cyst. After a period of quiescence it produces a new colony by simple cell-division, the remains of the spiny coat being visible for a time. A colony of two cells with integument measures about 55 μ × 45 μ; a colony of four about 85 μ × 60 μ. For mounting, it is recommended to place the material with water at one end of a dish, which is covered over except at the opposite end; the organisms then leave the mud and travel towards the illuminated end, and can be removed with a pipette and preserved in the following solution;—Copper acetate 0·5 grm., distilled water 100 c.cm.; mix, and add at ordinary temperature gum acacia 65 grm.; when it is dissolved, add pure glycerin 55 c.cm., mercuric chloride 2 grm.; filter before use.

Reproduction of Anabæna.*— F. E. Fritsch continues his studies on the Cyanophyceæ, and describes his researches on *Anabæna Azollæ*. He finds that the spore-contents in germination are either protruded from the ruptured spore-membrane by the formation of mucilage, or the spore-membrane itself becomes mucilaginous, while the contents retain their original position in the thread. The gonidia are formed by rejuvenescence, acquire a well-marked membrane, and are liberated by one of two methods resembling those of spore-germination. The spores have the power of germinating at once, while the gonidia pass through a resting period after liberation.

Cyanophyceæ.†—O. P. Phillips publishes a comparative study of the cytology and movements of the Cyanophyceæ. He comes to the conclusion that these plants are much higher in their organisation than has been supposed, possessing, as they undoubtedly do, a chromatophore and true nucleus. The nucleus undergoes part, at least, of the karyokinetic process; and the chromatophore is also primitive, combining the function of a colour-bearing organ with that of the cytoplasm. The cell consists of a nucleus, a thin colourless ectoplasm, and between them a thick band of pigmented cytoplasm — the chromatophore. In the latter are located the cyanophycin-granules and slime-balls, which are both probably food products. The nucleus divides by one of two methods: either it stops short at the net-spireme stage and constricts itself into halves; or it continues further and forms a rudimentary spindle with rudimentary chromosomes upon linin-threads. The movements of *Oscillaria*, *Cylindrospermum*, etc., are explained by the presence of delicate protoplasmic cilia, which radiate from the nucleus outwards through pores in the cell-wall. Similar protoplasmic processes occur on the end cells of *Oscillaria*, etc. The protoplasts of the cells of filamentous Cyanophyceæ are all connected by fine protoplasmic threads, which pass through pores in the wall, especially a central pore. The heterocyst is a modified vegetative cell packed with some substance, perhaps modified chromatin. Spores are formed in *Oscillaria* by the fusion of two or more cells of the filament. The cell-wall is of

* New Phytologist, iii. (1904) pp. 216–28 (1 pl.).
† Contr. Bot. Lab. Univ. Pennsylvania, ii. (1904) pp. 237–335 (3 pls.).

cellulose at first, and later resembles fungus-cellulose. The cell-wall is laid down as microsomata, in lamellæ on the inside of the cell-wall. A long bibliography is appended.

Phytoplankton of Donjec.*—L. Reinhard has made a study of the phytoplankton of the Donjec, and finds that the forms which are characteristic of larger rivers are for the greater part wanting there, *Melosira granulata* being almost the only exception. On the other hand, the flora is rich in Limno- and Heleoplankton forms, as Volvocineæ, *Pediastrum*, *Scenedesmus*, etc. This is attributed to the fact that the Donjec is rich in bays which penetrate far into the land, and attain the character of closed basins. In these the plankton is developed, and floats thence into the main stream. The number of species found in a short stretch of the river during a month's work was 135.

Clementsia Markhamiana.†—G. Murray gives the following description of this new pelagic genus and species:—"Units existing in colonies within a stratified integument, dividing into groups of four, varying much in the numbers of the colony; the integument gradually growing in thickness and in stratification; ultimately bursting and permitting the escape of the unit cells; unit cells increasing in size markedly and (presumably) subdividing into colonies like the parent colony; in nearly every stage characterised by the thick and many times stratified walls of the integument, and especially also by the abundant oily and chlorophyllaceous contents of the cells." It was collected in the Atlantic a few degrees south of the Equator during the outward voyage of the *Discovery*. Four stages in its life-history are figured in colours. The data given are strongly suggestive of *Glæocystis*, but the affinities are not stated.

Division in Desmids under Pathologic Conditions.‡—J. A. Cushman has examined species of *Cosmarium*, *Euastrum* and *Micrasterias*, in which the process of division was taking place in the digestive tract of certain Entomostraca. The newly-formed cells are contorted, and quite unlike the species. A figure is given of a species of *Micrasterias*, showing two quite dissimilar semi-cells.

Penicillus and Rhipocephalus.§—A. and E. S. Gepp describe two novelties—*Penicillus pyriformis* and *P. Lamourouxii* Decaisne var. *gracilis*—both collected in the West Indies by Mr. M. A. Howe. *P. pyriformis* differs from the common species, *P. capitatus*, in having a pear-shaped capitulum composed of interlacing filaments; the stalk barely penetrates into the head. The new variety of *P. Lamourouxii* is intermediate between that species and *P. capitatus*. It closely resembles *P. Lamourouxii* in habit, as also in its thin-walled, compressible, usually flattened stem, which penetrates but a very short way into the capitulum. It differs from *P. capitatus* in having coarser filaments and a soft compressed stem, not nearly penetrating to the middle of the capitulum. The unicellular character of both *Penicillus* and *Rhipocephalus* is insisted

* Arb. Nat.-forsch. Gesell. Univ. Charkow, xxxix. (1904).
† Geogr. Journ., xxv. (1905) pp. 121–3 (1 pl.).
‡ B[illegible] [illegible]4) p. 234. § Journ. Bot., xliii. (1905) pp. 1–5 (1 pl.).

upon. Passing on to *Rhipocephalus Phœnix*, the authors break up that species into three varieties—*typica*, *brevifolia*, and *longifolia*; and refer to the last of these a remarkable specimen from Florida, which bears flabella nearly 5 cm. long.

Microspores of Diatoms.*—G. Karsten has made some interesting and important observations on the so-called "microspores" of a new species of plankton diatoms—*Corethron Valdiviæ*—brought home by the German Deep Sea Expedition from the Antarctic Seas. It is a common species, and was found in a normal condition, with microspores as well as with plentiful auxospores. The cell-contents were seen divided in multiples of 2 up to 128, and consisted of globular cells surrounded by a protoplasmic membrane. The author succeeded in finding stages of division from 16 to 32, in which nuclear spindles were just being formed. The nuclei all divide simultaneously, and the chromatophores also divide. Eventually, these globular cells escape, and are found hanging in masses entangled among the spines of mature individuals. It has been suggested that these cells in another genus (*Rhizosolenia*) are either true spores which grow into a mature individual, or that they are male cells which copulate with other cells, and thereby occasion the formation of auxospores. The author, however, finds that they are in reality neither the one nor the other. The microspores of different origin unite in pairs and form a zygote, the further development of which is traced as far as possible on the material at the author's disposal, and the different stages are described and figured. The process may be summarised briefly. Gametes from two mother-cells unite in pairs, the zygotes increase in size and produce two daughter-cells of similar orientation. Each daughter-cell possesses two similar nuclei. During the gradual development of the upper end of the cell, the nucleus situated at that end increases in size, while the lower nucleus diminishes. By the time the shell, or frustule, begins to form, the small nucleus has disappeared. After the crown of notches has been formed on the upper shell, the young plant bursts through its shell, and stretches out to form a complete *Corethron Valdiviæ*. The bristles, the second shell, and the girdle develop gradually, and the normal length is attained by elongation of the girdle bands, while the diameter may be increased by the formation of auxospores. The main interest of the above described development lies in its parallelism to that of the Desmid zygote, which is discussed; and new points of relationship are brought forward.

Diatoms of the Montagne Noire, Pyrenees.†—J. Comère has examined a collection of diatoms made in the basins and canals which supply water to the Canal du Midi. The results of the six different gatherings are presented in tabulated form, and include sixty-six species. Of these, one only appears to be new for the south-west of France—i. e. *Cymbella anglica*—which occurs abundantly in most of the samples. The entire collection shows a mixture of epiphytic and limnophilous forms, such as *Cocconeis*, *Rhoicosphenia*, *Epithemia*, etc.; and of forms which

* Ber. Deutsch. Bot. Gesell., xxii. (1904) pp. 544–54 (1 pl.).
† Bull. Soc. Bot. de France, li. (1904) pp. 338–45.

prefer cold and rapid water and are commonly found in mountainous regions, such as *Ceratoneis Arcus* and *Odontidium hyemale*. The author closes his paper with an observation of biological interest regarding the algæ of this Canal du Midi. He finds that since the augmentation of traffic, and consequent necessity for frequent opening of the locks, the development of the algal flora has diminished, and many species have disappeared. This is, he considers, owing to the want of stagnant water in which certain diatoms, desmids and other algæ, find their most favourable habitat.

Laminaria bullata.*—Olga Mueller has made a study of the vegetative thallus, and gives the results under three sections: External Morphology, Anatomy, and Haptere. The material examined was collected at Port Renfrew, B.C., and was found growing attached to rocks where the tidal currents were very strong. They grew in the sublittoral zone, and could only be collected at low tide and with difficulty. The plant is a perennial. It consists of three tissues, the epidermal, the cortical, and the pith. Only the first two are found in the hapteres, while the stipe and lamina contain them all. Figures are given of the structure of various parts of the plant.

Demonstration of Masked Chlorophyll in Laminaria.—T. Berwick publishes a revised note on *Laminaria*, in which he details several experiments which serve for showing masked chlorophyll in that genus, and are useful for class purposes. The first experiment is described as follows:—If a frond of *Laminaria* of any length—the longer the better—after being simply air-dried, be passed with moderate rapidity with both hands through an ordinary bat-wing, or Bunsen flame, at once the brown colouring matter (phycophæin) disappears, the discharge of a misty vapour accompanying the change.

Endocladia muricata.‡—F. M. Warner publishes some remarks on this alga, and describes both its external habit and structure. He agrees with Setchell and Gardner as to the internal identity of *E. muricata* with *E. hamulosa*. The plants of *E. muricata* were found growing on rocks and boulders in the upper portion of the littoral zone very near high-water mark. A plate shows good figures of the structure.

Florideæ.§—G. B. De Toni has published the final section of his "Sylloge Floridearum," being part of his "Sylloge Algarum." The present section contains Gloisiphoniaceæ, Grateloupiaceæ, Dumontiaceæ, Nemastomaceæ, Rhizophyllidaceæ, Squamariaceæ, and Corallinaceæ; as well as the index to the whole of the Florideæ. Finally, the author gives in an appendix the names of all genera and species published since the appearance of the earlier sections, thus bringing the treatment of Florideæ up to date. Except in the case of new genera and a few species, the names in the appendix stand with their references only, and sometimes their habitat, without diagnoses.

* Minnesota Bot. Stud. ser. iii. (1904) pp. 303–8 (1 pl.).
† Trans. Proc. Bot. Soc. Edinburgh, xxii. (1904) pp. 395–6.
‡ Minnesota Bot. Stud., ser. iii. (1903) pp. 297–302.
§ Sylloge Algarum, iv. Florideæ, sect. 4 (1905) pp. 1523–1973.

Callymenia phyllophora.*—Clara K. Leavitt gives some observations on this alga, which was collected at the Port Renfrew Station, B.C. She summarises her remarks under the following heads: Habitat, Gross Structure, Minute Structure, Lamina, Fruit, Parasites. She finds that the plant is elittoral, and occurs in crevices in the rocky caverns where the tidal surge is strong. Only young plants were uncovered by low tides; mature plants were well beyond low tide line. The stipe and lamina are both composed of three layers of tissue: an epidermis, of 3–5 cells in thickness; a cortex, 2 or 3 cells deep; and a "pith strand, occupying the main cross section." Plants of *Microcladia Coulteri* and *Chlorochytrium inclusum* were found on and in *Callymenia phyllophora*.

Lithothamnia of the Adriatic and Morocco.†—M. Foslie describes collections of these algæ made in Rovigno, the Brionic Islands, Cherso, and on the coasts of Morocco. Sixteen species, with their forms, are described from the Adriatic, and very full critical notes are appended to the records. Among many other points of interest, the author shows that the genus *Sphæranthera* of Heydrich cannot be maintained, as *S. decussata* includes at least two different species, one of which is *Lithothamnion Philippii* Foslie. Fifteen species are recorded from the coasts of Morocco. The paper is illustrated by three quarto plates, containing eighty photographs of plants, natural size.

Marine Algæ of East Greenland.‡—H. Jonsson has examined collections from this coast made by C. Kruuse, and finds the number of species recorded from there is largely increased. Rosenvinge's statement as to the difference between the marine flora of East and West Greenland is confirmed. The list published by Jonsson includes all the marine algæ known at present from East Greenland, and they amount to 114 species. Interesting critical notes are in many cases appended to the records.

Marine Algæ of Jan Mayen.§—H. Jonsson enumerates fifteen marine algæ collected on this island by C. Kruuse, six of which are new records. The previously known flora for Jan Mayen included twenty-one species.

Algal Flora of the Sandwich Islands.‖—E. Lemmermann has examined collections of marine and fresh-water algæ, including diatoms and Peridineæ, made by Dr. Schauinsland on various islands in the Sandwich group. The additions to the flora made by these collections number 178, bringing the total number of species recorded from the islands up to 461. The aerophilous algæ are poorly represented, while the limnophilous species are plentiful. Thermophilous species occur in the hot waters on Hawaii; halophilous species in the crater lake, Moanaloa, near Honolulu, and in the lagoon of Laysan. As regards marine forms, the three commonest among large species are *Sargassum*

* Minnesota Bot. Stud., ser. iii. (1904) pp. 291–6 (2 pls.).
† Wiss. Meeresunters. Kiel. Biol. Anst. Helgoland, vii. (1904) pp. 1–40 (3 pls.).
‡ Medell. om Grönland, xxx. (1904) 73 pp., 13 figs.
§ Bot. Tidssk., xxvi. (1904) pp. 20–1.
‖ Engler, Bot. Jahrb. v. (1905) pp. 607–63 (2 pls.).

polyphyllum, *Turbinaria ornata* and *Ahnfeltia concinna*, the latter being in as great profusion as is *Fucus* on British coasts. A table of plankton is given. A systematic treatment follows, in which the records are often accompanied by critical notes. Eight new species are described and several new varieties.

ANONYMOUS—**Diatoms at Spurn.**
[Records a collection of 53 species of diatoms made on the occasion of the recent visit to Spurn of the Yorkshire Naturalists' Union. An abundance was found of *Actinocyclus Roperii*, and three species new to the Hull district are recorded.] *Naturalist*, 1904, pp. 379–80.

ARTARI, A.—**Der Einfluss der Konzentration der Nährlösungen auf die Entwickelung einiger grüner Algen.** (The influence of concentration of nutritive solutions on the development of certain green Algæ.)
Pringsheim Jahrb. Wiss. Bot., xl. (1904) pp. 593–613.

BEIJERINCK, M. W.—**Chlorella variegata, ein bunter Mikrobe.** (*Ch. variegata*, a coloured microbe.) *Rec. Trav. Bot. Neerland.*, i. (1904) pp. 14–28.

" " **Das Assimilationsprodukt der Kohlensäure in den Chromatophoren der Diatomeen.** (The assimilation product of carbonic acid in the chromatophores of diatoms.)
Tom. cit., pp. 28–33.

BORGESEN, F.—**Om Færöernes Algevegetation. Et Gensvar. I.** (On the algal vegetation of the Faeröes.)
[A detailed and searching criticism on the paper of Messrs. Porsild and Simmons on this subject in a previous number of the same journal (p. 149).]
Botan. Notiser., 1904, pp. 245–74.

BREHM, V., & E. ZEDERBAUER.—**Beiträge zur Planktonuntersuchung Alpiner Seen.** (Contributions to our knowledge of the plankton of Alpine lakes.)
[Describes the results of an investigation of Lakes Garda, Loppio, and Caldonazzo. The plankton is largely zoological. In the last-named lake, however, *Oscillaria rubescens* occurred in such masses as had only been seen by the authors in the Lake of Zell.]
Verh. K. K. Zool. Bot. Gesell. Wien. liv. (1904) pp. 635–43.

COLLINS, F. S.—**Algæ of the Flume.**
[An account of over a dozen algæ encrusting the walls of a damp, deep, and narrow ravine in New Hampshire.] *Rhodora*, vi. (1904) pp. 229–31.

DAVIES, J. H.—**A rare Alga in the Upper Bann.**
[Specimens of *Cladophora ægagropila* were observed last July growing *in situ*, as large flat patches submerged and imbedded in the sandy debris of the River Bann at Knochnagor, co. Down.]
Irish Naturalist, xiv. (1905) p. 39.

DAVIS, B. M.—**The Sexual Organs and Sporophyte Generation of the Rhodophyceæ.**
[Treats of Nemalion.] *Bot. Gazette*, xxxix. (1905) pp. 64–6.

GAIDUKOW, N.—**Ueber den Einfluss farbigen Lichtes auf die Färbung der Oscillarien** (On the influence of coloured light on the coloration of the *Oscillariæ*.)
Script. Hort. bot. Univ. Petrop., xxii. (9 pls.).

GERASSIMOW, J. J.—**Ätherkulturen von Spirogyra.** (Ether cultures of *Spirogyra*.)
[Describes the swelling of cells which contain a nucleus, caused by the ether; the cells and the chambers which have not a nucleus are not affected by the ether. The author therefore concludes that the ether acts on the nucleus itself, exciting it to activity, the result being the swelling of the cell-wall surrounding it.]
Flora, xciv. (1905) pp. 79–85 (7 tables).

GERASSIMOW, J. J.—**Ueber die Grösse des Zellkerns.** (On the size of the nucleus.) [Observations made on *Spirogyra*.] *Beih. Bot. Centralbl.*, xviii. Abt. 1 (1904) pp. 45–118 (2 pls.).

" " **Ueber die kernlosen und die einen Uberfluss an Kernmasse enthaltenden Zellen bei Zygnema.** (On the non-nucleated cells and those containing an excess of nuclear substance in *Zygnema*.) *Hedwigia*, xliv. (1905) pp. 50–6.

HARDING, H. A., & F. C. STEWART—**Vitality of Pseudomonas campestris (Pam.) Smith on Cabbage Seed.** *Science*, ii. (1904) pp. 55–6.

HARDY, A. D.—**The Fresh-water Algæ of Victoria.** [A more or less general and popular account of the group.] *Victorian Naturalist*, xxi. (1904) pp. 81–7.

KOHL, F. G.—**Zur Frage nach der Organisation der Cyanophyceenzelle und nach der mitotischen Theilung ihres Kernes.** (On the question of the organisation of the cell in *Cyanophyceæ* and the mitotic division of its nucleus.] *Beih. Bot. Centralbl.*, xviii. Abt. 1 (1904) pp. 1–8.

KRASKOWITS, G.—**Ueber Algenvegetation an Norwegens West-Küste bei Bergen.** (On the algal vegetation of the West Coast of Norway near Bergen.) *Mitt. Naturw. Ver. Univ. Wien*, ii. (1904).

LLOYD, F. E.—**Development of the Egg in Vaucheria.** *Plant World*, vii. (1904) pp. 311–12.

MIGULA, W., & SCHMIDLE, W.—**Algæ Hochreutinerianæ Oranenses.** (Algæ collected by Hochreutiner in Oran in Algeria.) Hochreutiner's *Le Sud Oranais*, Geneva, 1904, pp. 248–9.

MIQUEL, P.—**Du Noyau chez les Diatomées.** (On the nucleus of Diatoms.) *Micrograph. Préparat.*, xii. (1904) pp. 167–75.

OLIVE, E. W.—**Mitotic division of the Nuclei of the Cyanophyceæ.** *Beih. Bot. Centralbl.*, xviii. Abt. 1 (1904) pp. 9–44 (2 pls.).

PAULSEN, O.—**Plankton-Investigations in the waters round Iceland in 1903, with two maps.** *Meddel. Komm. f. Havunders. Ser. Plankton*, i. (1904).

PÉNARD, E.—**Étude sur la Chlamydomyxa montana.** (Study of *C. montana*.) *Arch. Protistenkunde*, iv. (1904) pp. 298–334 (1 fig.)

SCHERFFEL, A.—**Notizen zur Kenntniss der Chrysomonadineæ.** (Notes on *Chrysomonadineæ*.) *Ber. Deutsch. Bot. Gesell.*, xxii. (1904) pp. 439–44.

SCHORLER, B.—**Bereicherungen der Flora Saxonica im Jahre 1903.** (Additions to the flora of Saxony in 1903.) *Abh. Naturw. Gesell. Isis. Dresden*, i. (1904) pp. 28–34.

SVEDELIUS, N.—**Algen aus den Ländern der Magellanstrasse und Westpatagoniens.** (Algæ from the regions of the Magellan Straits and West Patagonia.) *Svensk. Exped. till Magellansländerna*, iii. No. 8 (1904).

WILLE, N.—**Die Schizophyceen der Plankton Expedition.** (The Schizophyceæ of the Plankton Expedition.) *Ergebnisse Plankton Exp. Humboldt-Stiftung*, 1904, 88 pp. 3 pls.

Fungi.

(By A. LORRAIN SMITH.)

The Wintering of Peronospora in the Vine.*—J. von Istvanffi finds that the continuance of this fungus is due not only to the oospores which are imbedded in the tissue of the leaves, but that the mycelium

* Ber. bot. Sect. Kgl. Ungar. Naturwiss. Ges., iii. (1904) pp. 74–7 (3 figs.). See also Bot. Centralbl., xcviii. (1905) p. 97.

also persists in the sheath leaves of the shoot and in the woody p... the twigs. In the latter case it penetrates deeply. This mycel... the product of a late autumn infection by the *Peronospora*.

Membrane of Zygospore.*—P. Vuillemin has investigated... formation of the outer layers of the mature zygospore. He finds... there are five principal layers, alternately thin and thick. The... noticeable is the fourth layer, which is next to the outer coating... distinguished by its elasticity and by the brown coloration... author terms it the carbon layer (assise charbonneuse). He d... the formation of these protective layers in various types of Mu... *Sporodinia Aspergillus*, *Spinellus rhombosporus*, *S. chalybeus*, ... *rhynchus heterogamus*, *Z. Moelleri*, and in *Mucor fragilis*. He st... conclusion, that the protoplasm of the zygospore manifests no... dermato-genetic property. The wall formed is strong and thi... does not differ from the wall of the copulating gametes; gr... gradual and continuous both in time and dimensions.

Hyphoids and Bacteroids.†—P. Vuillemin finds in the root... cles of Leguminosæ, filaments of a fungal nature resembling th... *Pythium*. They often show swellings, either terminal or int... which have no connection with the *Pythium* fructification. Th... describes them under the term hyphoid, as they have undergo... thing of the same transformation as the bacteroids of *Rhizob*... they are not parasites, but, like the root bacteria, live in symbio... the roots of the host.

Tobacco Disease due to Sclerotinia.‡—C. A. J. A. Ouden... C. J. Koning have investigated a "rot" of tobacco plants d... fungus. It develops as fine white filaments on the surface of... or stalk. From these, conidiophores are developed, and, lat... sclerotia are formed. The fungus was also cultivated success... saprophyte on malt-gelatin, etc. The *Peziza* from *Sclerotinia* ... sp. n. was grown from the sclerotium. The disease only occu... years, and care should be taken to avoid moist conditions, s... great shade, and to secure the speedy drying of the lea... gathered, as the fungus spreads very rapidly among damp l... a further note,§ the authors record successful cultures of th... and the growth of much larger *Peziza* forms than those at firs...

Two Supposed Species of Ovularia.‖—E. S. Salmon giv... for regarding *Ovularia fallax* and *O. Clematidis* as synonyms... *Polygoni*. The former has been found on *Vicia*, the latter o... both of them hosts of *Erysiphe Polygoni*. These fungi are ... of *Oidium*, and identical with *Oidium leuconicum*, the co... of *Erysiphe Polygoni*.

Notes on the Occurrence of Black Rot.¶—A. Prunet g... details as to the time when the vines are most likely to be ...

* Ann. Mycol., ii. (1904) pp. 483–506 (4 pls.).
† Comptes Rendus, cxl. (1905) pp. 52–3.
‡ R. Akad. Wetensch. Amsterdam, vi. (1903) pp. 48–58 (1 pl.).
§ Tom. cit., pp. 85–6 (1 pl.).   ‖ Journ. Bot. xliii (1905) pp. 4...
¶ Rév. Vitic., xxii. (1904) pp. 289–91. See also Bot. Centralbl., xcvi...

this disease. The first attack is due to the ascospores of the fungus. The perithecia are developed on vegetable remains on the ground, and the spores are expelled during the first rainy season. The wind carries them to the vines, and pycnidia are formed. The spores of the pycnidia first formed are washed over the branches by subsequent rains, and the spread of the fungus is secured. The precise dates of attack and further spread of the disease are thus ascertained, and measures can be more easily taken to check the mischief.

Mycological Notes.*—P. Magnus gives here the diagnosis of a rather unusual species of *Erysiphe* found on *Asteriscus aquaticus*. It is characterised by the somewhat flat apothecia, which are held so firmly to the leaf by the appendages that the surface of the leaf becomes depressed by the pressure of the fungus. Magnus also publishes notes on some Hyphomycetes; *Ovularia pusilla* should be called *O. aplospora*, and *Helminthosporium Diedickei* should be *Brachysporium Crepini*.

Further Cultural Experiments with Biologic forms of the Erysiphaceæ.†—In a recent paper, E. S. Salmon described methods of culture in which he wounded, or otherwise injured, a host plant hitherto immune to the fungus, and thus rendered it liable to infection. For such a case he proposes the terms *xenoparasite* and *xenoparasitism*. In the case of the specialised fungus on its proper host under normal conditions, he uses the terms *œcoparasite* and *œcoparasitism*.

He found that though he could, by wounding or weakening the host plant, induce a "strange" form to grow on it, yet, in the following generation, the spores so produced refused to germinate on the same host if it were in a healthy condition, while they germinated readily on the host on which the form normally grew. The injuries that rendered the plant liable to infection were mechanical, by cuts or bruises, or they were caused by interference with the normal functions of the cell by the application of alcohol, ether, or heat. A detailed account of the various experiments is given.

Vitality of Yeast in Varying Conditions.‡—W. Henneberg worked with pure cultures of yeast, of which he tested the vitality under the varying influences of moisture, temperature, illumination, etc. He found that the different races of yeast exhibited different properties, some having more power of resistance than others. A series of researches was directed to the influence exerted by foreign organisms, moulds, bacilli, etc., in the yeast cultures. Some of these gave off very strong odours; he did not find, however, that they were directly injurious to the growth of the yeast, except in so far as they used up the nourishment, and so impoverished the culture medium.

Nuclear Fusion in Yeast Spores.§—Gaston Bonnier notes the results arrived at by various workers on this subject, and re-examines a number of cases already experimented on. In *Saccharomyces Mellacei*,

* Hedwigia, xliv. (1904) pp. 17–18.
† Ann. Bot., xix. (1905) pp. 125–48.
‡ Centralbl. Bakt., xiii. (1904) pp. 641–5.
§ Comptes Rendus, cxxxix. (1904) pp. 988–90.

fusion never takes place between the spores. On germination they sometimes, in addition to the germinating tube, put out a small bud which looks somewhat like a fused spore. In *S. Ludwigii* he finds undoubted conjunction of spores and fusion of nuclei; conjugation constantly taking place within the ascus before its walls have broken down. In *S. Johannisberg* ii. and *S. Saturnus*, conjugation may take place between two spores before germination, but there are frequent cases of germination from single spores representing parthenogenesis. In *S. Johannisberg* ii. the two nuclei do not fuse until the united spore has begun to germinate.

Diseases due to Cladosporium.* — G. D. Ippolito finds that the dark-coloured spots on seeds of wheat are due to *Cladosporium herbarum*. The epicarp and the underlying starch-sheath are attacked. On the germination of the seeds, the mycelium of the fungus grows with the embryo, and causes yellow spots on the stem.

The same author† found *Cladosporium Pisi* infecting the hulls of peas. It pierces the epidermis, and lives as a saprophyte on the tissue which it has destroyed.

E. Lasnier ‡ also publishes some notes on a disease of peas due to *Cladosporium herbarum*. He finds that the peas are small and deformed; the mycelium enters by the funicle, and the invaded tissues become brown. A similar fungus has been recorded as *Cl. Pisi*, but the author sees no morphological difference between that fungus and *Cl. herbarum*. It is usually considered to be a saprophyte, but in this case, as in some others, *Cladosporium* is a true parasite. In artficial cultures, the *Hormodendron* form was produced with branching conidia at the apex of the conidiophore.

Disease of Larch.§ — C. A. J. A. Oudemans describes a fungus disease of Larch which affects the leaves, covering them over by its growth, closing the stomata, and interfering with assimilation, causing the leaves to become brown in colour. The fungus forms minute fruits, consisting of brownish spores growing in chains, and forming compact pustules. It differs from the neighbouring genera *Trimmatostroma* and *Exosporium* in having no stroma, and has been placed by the author in a new genus, *Exosporina*, with the specific name *Laricis*.

Isaria forms of Penicillium.‖ — P. Vuillemin disapproves of the grouping of ill-defined species in the genus *Isaria*. He finds that *Isaria destructor*, which has been placed by some authors in *Oospora*, is really a form of *Penicillium*. It is a parasite on insects, and should be known as *P. anisopleæ*. The writer makes notes on *P. Briardi*, also parasitic on insects, and previously classified as *Isaria truncata*.

* Stazioni sperim. Agrar., xxxvi. (1903) pp. 1009–14. See also Centralbl. Bakt. xiii. (1904) p. 779.

† Sul Cladosporium Pisi Cug. e Macch., 9 pp., Trani, 1904. See also Centralbl. Bakt. xiii. (1904) p. 779.

‡ Bull. Soc. Mycol. France, xx. (1904) pp. 236–8 (1 pl.).

§ K. Akad. Wetensch., Amsterdam, vi. (1904) pp. 498–501 (1 pl.).

‖ Bull. Soc. Mycol. France, xx. (1904) pp. 214–21 (1 pl.).

Morphological and Biological Characteristics of Penicillium Species.* — The recorded species of *Penicillium* are about sixty in number, most of them so imperfectly described that it is impossible to recognise them. O. Stoll has taken up this difficult genus, and has described seven species from well authenticated growths, most of them cultivated by himself. *Penicillium brevicaule* he found on old tapestry; *P. olivaceum* and *P. italicum* grew on oranges and citrons; *P. rubrum* on straw in a hen-house; *P. glaucum* was found everywhere. In each case he describes the conidial form of fructification, and the behaviour of the fungus in regard to the substratum, and he gives accurate measurements and descriptions of the conidia. Under certain conditions *P. glaucum* develops a colourless form, *P. candidum* Link.; when re-infected on potato, the usual colour is again produced. Further work is needed to determine the other species not dealt with by Stoll.

Rusts of Pines.†—D. H. C. Schellenberg observed that the rust of *Pinus Cembra* alternated with *Cronartium* on *Ribes alpinum*. Further study proved that it was the same rust that attacked *Pinus Strobus*, known as *Peridermium Strobi*. It is a well-known and frequent parasite in Alpine pine woods.

Pucciniæ found on Umbelliferæ.‡—O. Semadeni concludes a long account of these fungi. He recounts the different infection experiments with their results. Thus, he finds that *P. bullata* is to be regarded as a "collective species," including one or more biological species. He establishes a new species, *P. Pozzii* on *Chærophyllum hirsutum* var. *glabrum*, and shows that *Æcidium Mei* has as Puccinia form *P. mamillata* Schroeb. on *Polygonum bistorta* and *P. viviparum*. He gives the new name *P. Mei-mamillata* to the species. Another form on *Angelica* he terms *P. Angelicæ-mamillata*.

Notes on Uredospores of Uromyces brevipes and U. punctato-striatus.§—P. Dietel describes two kinds of uredospores on *Uromyces brevipes*. The primary spores, which appear on the stronger veins and petioles of the leaf, cause slight deformations. The secondary spores are smaller, and appear mixed with teleutospores. There are other differences in the markings of the spores. *Uromyces punctato-striatus* is, like the previous species, a parasite of *Rhus*. There are primary and secondary spores, but in this case the secondary spores grow in sori on the under side of the leaf.

On the Vegetative Life of some Uredineæ.‖—Jakob Eriksson here re-states his theory of the propagation of rusts by a mycoplasma contained in the tissue of the host, and gradually developing into fungal hyphæ and rust sori with spores. He states finally that "the question where the plasmodia in the leaves of the corn-plants have come from, must be left for further investigation."

* Inaug. Diss. Wurzburg, 1904, 56 pp., 5 pls. See also Bot. Centralbl., xiii. (1904) pp. 770–3.

† Naturwiss. Zeitschr. Land. Forstw., 1904, p. 233. See also Centralbl. Bakt. xiii. (1904) pp. 659–60.

‡ Centralbl. Bakt., xiii. (1904) pp. 527–43 (5 figs.).

§ Ann. Mycol., ii. (1904) pp. 530–3.

‖ Ann. Bot., xix. (1905) pp. 55–9.

Notes on Uredineæ.* — P. Hennings records a new and harmful species of rust, *Uredo Wittmackiana* on *Epidendrum*, from Orizaba, in Mexico. It differs considerably from the species previously found on the plants of this genus.

Shunsuke Kusano † describes several new forms of *Uromyces* and an *Æcidium* on species of *Sophora*. E. V. Oven ‡ gives an account of *Phragmidium* on various kinds of roses. He gives the names of the varieties that were, more or less, subject to attack in the grounds of the Pomological Institute at Proskau.

W. L. Balls § publishes notes on the infection of plants by rust-fungi. He thinks they are probably in search of watery vapour when they penetrate the stomata of the host. He gives an acount of an experiment he made to test this theory.

In discussing the occurrence of rusts in the neighbourhood of Toulouse, A. Prunet ‖ notes that the only one that attained serious proportions during the year 1903 was *Puccinia triticina* on corn.

Recent Researches on the Parasitism of Fungi.¶—In a discussion of this whole question, Marshall Ward begins with an historical survey of the progressive knowledge of the subjects both of bacteria and fungi, leading on to the great development of the science of Plant Pathology. He then confines himself to a consideration of the Uredineæ as parasites, sketches their life-history, classification, the modern view of their sexuality, and the methods of spore distribution. Data are given as to the work of insects in aiding the spread of fungi, and as to the length of time the uredospores retain their vitality, these facts having an important bearing on the theories affecting the unlooked-for appearance of rust in different localities. Specialisation in parasitism is next described and exemplified, and the various explanations of immunity and susceptibility are alluded to. Ward explains and refutes Eriksson's mycoplasm hypothesis, and gives the results of his own observations on infection and on susceptible and immune varieties of plants. In the latter case, though the spores germinated and entered the host plant in the normal fashion, in a few days they died off; either they were starved for want of food supply, or they were poisoned. He concludes that the phenomena were those of starvation: the hyphæ had clumsily killed the plant-cells, instead of delicately tapping them for food, and in turn died for lack of nutrition. Experiments were made to prove this theory, and it was found that the same results were obtained when there was a lack of carbon supply. Small nests of dead, brownish-coloured cells were produced, on which the parasite could not live. The paper concludes by re-stating the facts that go to prove how unnecessary any mycoplasma theory is to explain the appearance of rusts.

* Gartenflora, 1904, pp. 397–8. See also Bot. Centralbl., xcvi. (1904) p. 621.

† Bot. Mag. Tokyo, xviii. (1904) pp. 1–6. See also Centralbl. Bakt., xiii. (1904) p. 782.

‡ Naturw. Zeitschr. Land. Forstw., 1904, Heft 4–5. See also Centralbl. Bakt., xiii. (1904) p. 784.

§ New Phytol., iv. (1905) pp. 18–19.

‖ Assoc. Franç. pour l'Avanc. Sci. Angers, xxxii. (1904) pp. 731–3. See also Bot. Centralbl. xcviii. (1905) p. 98.

¶ Ann. Bot., xix. (1905) pp. 1–54.

Destruction of Birch and other wood by Polyporus nigricans.* Ivar Lindroth gives an account of the attack of this fungus not only on birch, but also on *Salix Caprea* and *Populus tremula*. Infection follows probably on deep wounds caused by frost, the breaking of branches, etc., enabling the fungus to reach the pith; the tissue surrounding the diseased spot becomes filled with gum. The author describes the gradual destruction of the cells by the fungus, and he also notes other species of *Polyporei* that attack the birch.

Notes on the Variability of Hypothele repanda.†—Howard J. Banker has reviewed the different accounts of this species, known generally as *Hydnum repandum*. It varies so much in habit and colour that it has been split into three species, which the writer thinks may probably become well-established. He describes a form he himself found with flattened teeth, growing in comparatively wet ground. In a drier situation the same fungus was found showing very few of these flattened teeth, or in some cases none at all.

Spore Dispersion in the Basidiomycetes, and the Biological Value of the Basidium.‡—Richard Falck has answered a number of interesting questions in the course of his investigation. He finds that pileate fungi scatter their spores over a fairly wide area, even in enclosed chambers, which are secure against air-currents; and that the larger the fungus is, or the more of them there are together, the further are the spores disseminated. He notes also that while the Polyporei deposit the spores in somewhat symmetrical fashion, from the Agaricineæ they are carried away and deposited in lines and streaks that have no connection with the direction or form of the gills. In all fungi the spore deposit corresponds to some extent with the incidence of the rays of light. He has found that the fungus, by its own internal heat, establishes delicate air-currents, which suffice for the very wide-spread scattering of such light bodies. When the spores separate from the sterigmata, they fall first downwards, and are thus caught away by the currents and finally deposited, always on the upper surface of the area on which they alight. These self-engendered currents explain the wide dispersal in the enclosed room. The author, by experiments with light and temperature, found that their influence explained the lines and streaks formed by the falling spores. The character of the surface on which the spores alighted had no connection with these lines. Falck does not fail to allow full weight also to the air-currents due to wind and temperature.

The biological value of basidia are next considered; the author compares the different forms of fungi with reference to their sporophores; the basidium in this group of fungi suffices to raise the spores above the hymenium, and so enables them to fall free when they are ripe, and to be carried away by the lightest of currents.

The author devotes considerable attention to the problem of spore dissemination among the Uredineæ. The teleutospores are to be found on plant remains that have fallen to the ground and there passed the

* Naturw. Zeitschr. Land. Forstw., ii. (1904) pp. 393–406 (7 figs.). See also Bot. Centralbl., xcvi. (1904) pp. 624–5. † Torreya, iv. (1904) pp. 113–7.
‡ Cohn's Beitr. Biol. Pflanzen, ix. (1904) pp. 1–82 (6 pls.).

winter; in spring they germinate and produce sporidia, just at the time when earth-currents are being generated by increased temperature. They are wafted to any height or distance, fall on the upper surface of the leaves, and the germinating tube pierces the cuticle of the young leaf. The later spore forms are dispersed by the wind.

Falck returns to the Basidiomycetes to examine the signification of the various forms. He finds that pores, gills, folds, etc., are all adaptations to secure a greater hymeneal surface and an increased spore-production. The pileus, as already noted, serves for the evolution of heat and the formation of air-currents. He concludes by some accounts of spore dissemination in the Phycomycetes and the Ascomycetes, and discusses the economic value of fungi in regard to Nature and to man.

Two New Pests of the Vine in Hungary.*—Gv. de Istvanffi finds that *Ithyphallus impudicus* attacks the underground stock of the vine and destroys it. The mycelium infects first the soft bast and the cortical parenchyma; it then penetrates through the medullary rays to the wood and destroys them, until only a skeleton of the wood vessels is left. The other dealt with is an animal pest, *Cœpophagus echinopus*.

Practical Notes on the Beet Disease.†—A. Guttman traces the origin of this disease to *Phoma Betæ*. The seeds of the beet are already infected with the spores of the fungus, and circumstances determine if the young beet plant is able to throw off the attack. Weather, soil composition, and conditions of the beet plant are all important factors. Stormy weather and poor soil weaken the plant and encourage the growth of the fungus. The author recommends somewhat late sowing of the seed and thorough cultivation of the soil. Treatment of the seeds with some fungicide has been recommended, but has not proved advantageous.

Canker of Fruit Trees.‡—Rudolf Goethe holds that canker is due to the attack of the fungus *Nectria ditissima*, and not to bacteria, nor to the action of frost. In regard to the latter cause, he points out that with a frost wound there is no thickening and swelling of the tissue as there is in true canker. He describes the different kinds of canker, the kinds of trees that are liable to be attacked, and the conditions that favour the disease. He also recommends methods of extirpation and prevention.

Fungal Parasites of the Tea Plant.§—N. N. Speschnew is the author of a monograph on this subject, the first of a series dealing with the diseases of cultivated plants in Transcaucasia. He describes the fungi that cause disease, many of the species being new, and he advises as to the best methods for extirpating them.

* Ann. Inst. Centr. Ampelog. roy. Hongr., iii. Livr. 1, Budapest, 1904, viii. and 55 pp. (8 pls.) See also Bot. Zeit., lxiii. (1905) pp. 28–9.

† Deutsche Landw. Presse, 1904, p. 64. See also Centralbl. Bakt., xiii. (1904) p. 660.

‡ Ueber den Krebs der Obstbaume, P. Parey (Berlin, 1904) 34 pp. See also Centralbl. Bakt., xiii. (1904) pp. 662–3.

§ S.A. aus den Arbeiten Bot. Gart. Tiflis. ii. Lief. vi. Heft 3 (Tiflis. 1904) 83 pp. 4 col. pls. (Russian.) See also Bot. Centralbl., xcviii. (1905) pp. 40–1.

Mould Ferments from India.*—A. Nechitsch has studied the organisms used to produce fermented liquor in Sikkim and at Mount Khasia. The principal ferment used in the former region was *Mucor Praini*. The sporangiophores may grow to a height of 4 cm.; they divide into some six branches, terminating in sporangia with minute spores. Occasionally chlamydospores and yeast are produced. In the other case he found that fermentation was induced by a species of *Dematium*, *D. Chodati*, near to *D. pullulans*. The author also studied the effect of different salts on alcoholic fermentation.

Report on Fungicides.†—B. D. Halstead and J. A. Kelsey describe a series of leaf-diseases of cultivated plants, and the best methods of destroying the attacking fungi. Diseases of asparagus, potato, tomato, and pear are dealt with; a considerable portion of the report deals with a description of *Erysipheæ*. Twenty-nine species and six varieties, growing on 123 hosts, are recorded from the neighbourhood of New Jersey.

Mycological Notes.‡—L. Lutz collected sclerotia of *Claviceps purpurea* on *Psamma arenaria*. He placed them in suitable conditions for germination in November 1902, and kept them under observation until March 1904, when the *Peziza* form was produced. The author also records an attack of *Sclerotinia Fuckeliana* on *Quinquina* cultivated in Paris. The leaves were covered by the conidial form. Bordeaux mixture was used to kill the fungus.

Vegetable Pathology.§—A. Maublanc gives an account of a disease of olives due to *Macrophoma dalmatica*. The fruit is attacked while still immature, and the fungus gives rise to brown spots. It may possibly be a wound parasite, that gains entrance through the bite of an insect.

The author has devoted considerable attention to *Dasyscypha calyciformis*, recorded as a disease of Pines. He finds no evidence that the fungus is parasitic. The mycelium is never present except in wood or bark already killed by *Armillaria mellea*.

Inter-relation of Pests of Cereals.‖—J. B. Jungner has watched the action and development during a year of the various enemies of cereal plants, including insects, fungi, and unfavourable climatic conditions. He found that injury by frost was followed by attacks of numerous fungi, such as *Ascochyta*, *Sphærella*, *Septoria*, *Cladosporium*, and *Helminthosporium*. He discusses the dispersion of conidia and spores by wind and insects, and notes the case in which insects and fungi grow together or are closely related, as, for instance, *Capnodium*, which grows on the secretion of *Aphides*. Several cases of rust infection are given, following on attacks by insects; *Leptosphæria herpotrichoides* grew on leaves that had been infested by various insects.

* Inst. Bot. Univ. Genève. ser. 6, fasc. 5 (Genève, 1904) 38 pp. (1 pl. and 6 figs.). See also Bot. Centralbl., xcviii. (1905) pp. 36-7.

† Rep. Botanist, New Jersey Agric. Stat., 1903 (1904) pp. 459-54 (15 pls.). See also Bot. Centralbl., xcvi. (1904) p. 618.

‡ Bull. Soc. Mycol. France, xx. (1904) pp. 211-13.

§ Tom. cit., pp. 227-235 (15 figs.).

‖ Zeitschr. Pflanzenkr., xiv. (1904) pp. 321-47.

Assimilation of Atmospheric Nitrogen by a Turf Fungus.*—Ch. Ternetz found that, after carefully cleaning the roots of such plants as *Erica carnea*, *Calluna vulgaris*, *Vaccinium Vitis-idæa*, etc., and placing them on agar-agar, a pycnidia-forming fungus was always produced. The same fungus appeared in an agar-agar culture of crumbled turf. It was impossible to decide if this was the fungus that formed the mycorhiza of the roots. Experiments were conducted on a substratum wanting in nitrogen, and it was found that the fungus not only grew luxuriously, but that it gained in nitrogen.

Poisoning by Fungi.†—J. Hockauf discusses the whole question of fungus poisoning, the difficulty of determining the species of larger fungi, when one realises the great variability of form, and the chemical changes that may exist alongside of this variability. *Clitocybe nebularis* is a recognised edible in Munich; in other countries it is considered dangerous, and so with other species and varieties. The author cites many cases of poisoning, but data are wanted as to the age and condition of the fungi.

H. Steinvorth ‡ publishes new observations on poisoning by plants, the first chapter dealing with fungi. He cites cases where *Amanita phalloides*, *A. rubescens*, *A. pantherinus*, *Russula rubra*, and *Boletus Satanas*, collected in the neighbourhood of Hanover, were eaten with impunity.

Diseases of Sugar Beet in Bohemia.§—Franz Bubak found on the leaves of the Beet *Cercospora beticola* and *Ramularia Betæ*, the latter new to Bohemia, and gives rise to large greyish or brownish spots on the leaves. *Phyllosticta Betæ* is constantly found on the same spots, and the writer considers they are forms of the same fungus, some Pyrenomycete.

He has also ‖ devoted some attention to the disease caused to the roots by *Rhizoctonia violacea*. It is spread largely by the wind carrying small particles of earth to which are attached pieces of the mycelium of the fungus. The spores are still unknown. He gives an account of the various remedies tried to combat the disease.

Biological Species of Parasitic Fungi, and the Development of New Forms.¶—Ed. Fischer sketches the history of *Puccinia graminis*, and gives an account of Eriksson's work on the different biological species within the one morphological species. He states his belief that they have all come from the one form, and that the extent to which such specialisation arises testifies to the age of the parasite. Thus the

* Ber. Deutsch. Bot. Ges., xxii. (1904) pp. 267–74. See also Ann. Mycol., ii. (1904) pp. 557–8.
† Wiener Klin. Wochenschr., No. 26 (Wien, 1904), 19 pp. See also Hedwigia, xliv. (1904) Beibl., p. 14.
‡ Jahr. Naturwiss. Ver. Luneburg, xxi. (Luneberg, 1904) pp. 77–82. See also Hedwigia, xliv. (1904) Beibl., p. 18.
§ Zeitschr. Zuckerind. Böhmen Prag., 1904, Heft 7 (4 pp.). See also Hedwigia, xliv. (1904) Beibl., p. 28.
‖ Tom. cit., 2 pp. See also Hedwigia, xliv. (1904) Beibl., p. 29.
¶ Atti Soc. Elevet. Sci. Nat. Locarno, 86^{me} sessione, Zurigo, 1904, pp. 49–62. See also Hedwigia, xliv. (1904) Beibl., pp. 12–13.

Uredineæ must have existed as parasites during a longer period of time than *Botrytis* or than *Cuscua*. The phenomena are very complicated, and it is not always easy to decide whether they are not in some cases also morphologically distinct.

Diseases of Plants, with Methods of Prevention or Cure.* — J. Kindshoven recommends treatment by spraying with copper-lime or copper-soda solutions for the extirpation of fungal diseases. He proved the value of this method in overcoming an attack of Pears by *Fusicladium*.

W. Freckmann† describes the development of *Sclerotinia Trifoliorum*, which, he finds, attacks *Trifolium pratense*, *T. incarnatum*, *T. hybridum*, *T. pannonicum*, *Onobrychis sativa*, *Medicago sativa*, *Anthyllis vulneraria*, and *Lupinus perennis*. The fungus attacks plants three and four years old, as well as the seedlings. To stamp out the disease, it is necessary to prevent the sclerotia from germinating; they should be deeply ploughed in. A change of crop is also recommended.

ARTHUR, J. C.—**Revised list of Indiana Plant Rusts.**
[The list includes 105 species of plant rusts, representing sixteen genera.]
Proc. Ind. Acad. Sci. 1903 pp. 141–52.

BARBIER MAURICE—**Agaricinées rares, critiques, ou nouvelles de la Côte-d'Or.** (Rare, critical, or new agarics from the Gold Coast.)
Bull. Soc. Mycol. France, xx. (1904) pp. 225–7.

BASTIAN, H. CHARLTON—**The heterogenetic origin of Fungus-germs and Monads.**
Ann. and Mag. Nat. Hist., xv. (1905) pp. 210–17 (2 pls.).

BODEN, FR.—**Die Stockfäule der Fichte, ihre Entstehung und Verhütung.** (The rotting of firs and its prevention.)
[The writer discusses the culture of firs and the causes of disease among them.]
Hameln (1904) 91 pp., 1 woodcut, and 18 text figs.
See also *Centralbl. Bakt.*, xiii. (1904) p. 785.

BOYD, D. A.—**Notes on Fungi from West Kilbride, Ayrshire.**
[Popular account of the two striking species, *Hirneola Auricula-judæ* and *Lachnea coccinea*.] *Trans. Edinb. Field. Nat. Club and Micros. Soc.*, v. part i. (1904) pp. 77–8.

BUBAK, FR.—**In Böhmen im Jahre 1902 aufgetretenen Pflanzenkrankheiten.** (Plant diseases in Bohemia during the year 1902.)
[The account of plant diseases includes insects as well as fungal pests.]
Zeitschr. Landw. Versuchsw. Oesterr., 1904, p. 731.
See also *Centralbl. Bakt.*, xiii. (1904) p. 776–8.

COPELAND, EDWIN BINGHAM—**New or interesting California Fungi. II.**
[Diagnoses of nine new species are given.]
Ann. Mycol., ii. (1904) pp. 507–10 (1 pl.)

DELBRUCK, M., & A. SCHROHE—**Hefe, Gärung und Faulnis.** (Yeast fermentation and impurity.)
[The authors give the history of the whole subject of Fermentation and the Technology of the industry.] P. Parey (Berlin, 1904) 14 text figs.
See also *Bot. Zeit.*, lxiii. (1905) pp. 1–2.

* Prakt. Blatter f. Pflanzenbau u. Pflanzenschutz, 1904, pp. 53–4. See also Centralbl. Bakt., xiii. (1904) p. 670.

† Deutsche Landw. Presse, 1904, No. 51, pp. 452–4. See also Centralbl. Bakt., xiii. (1904) pp. 670–1.

Diedecke, H.—**Neue order seltene Pilze aus Thüringen.** (New or rare fungi from Thuringia.)
[The species all belong to the group of Microfungi, either Ascomycetes or Deuteromycetes; a number of them are new to science.]
Ann. Mycol., ii. (1904) pp. 511–14.

Galzin—**Du Parasitisme des Champignons Basidiomycetes épixyles. Suite.** (On the parasitism of wood-fungi. Basidiomycetes.)
[The author describes the changes produced in the wood by the different forms.]
Bull. de l'Assoc. Vosg. Hist. Nat. (July, 1904) No. 6, pp. 81–7.
See also *Bot. Centralbl.*, xcvi. (1904) p. 644.

" " **La Lenzites abietina B. saprophyte et les dégats qu'elle peut occasioner.** (*Lenzites abietina*, saprophyte, and the mischief it may give rise to.)
[This fungus attacks felled wood, and destroys it.]
Tom. cit., pp. 89–91. See also *Bot. Centralbl.*, xcvi. (1904) p. 644.

Hollos, J.—**Gasteromycetes Hungariæ cum tabulis XXXI.** (The Gasteromycetes of Hungary.)
[Commissioned by the Hungarian Academy of Science. Plates coloured in part from original drawings and photographs. Authorised German translation.] Osw. Weigel (Leipzig, 1904) fol., 211 pp.
See also *Hedwigia*, xlix. (1904) Beibl., p. 14–15.

Kostytschew, S.—**Untersuchungen über die Atmung und alkoholische Gärung der Mucoraceen.** (Research on the respiration and alcoholic fermentation of the Mucoraceæ.) *Centralbl. Bakt.*, xiii. (1904) pp. 577–89.

Krasnosselsky, T.—**Atmung und Gärung der Schimmelpilze in Rollkulturen.** (Respiration and fermentation of mould-fungi in cultures.)
Tom. cit., pp. 673–87 (6 figs.).

Krieger, W.—**Fungi saxonici. Fasc. 36. Nos. 1751–1800.**
[Descriptions are published of some of the species. The fascicle includes many interesting forms.]
Königstein, i. S., 1904. See also *Bot. Centralbl.*, xcvi. (1904) p. 623

Lazaro é Ibiza, de Blas—**Notas Micologicas; colleccíón de datos referentes á los Hongos de España.** (Mycological notes; series of data referring to the fungi of Spain.)
[The author gives an account of the appearance and occurrence of a number of fungi.] *Mem. Soc. Esp. Hist. Nat.*, ii. (1904) pp. 339–62.

Molliard, M.—**Un nouvel hôte du Peronospora Chloræ de Bary.** (A new host of *Peronospora Chloræ*.)
[The parasite has been found on *Cicendia*. It attacks the flower without injuring the seed.]
Bull. Soc. Mycol. France, xx. (1904) pp. 223–4.

Niger, F. W.—**Uredineæ et Ustilagineæ Fuegianæ, A. P. Dusen collecti.**
[A number of new species are recorded.]
Wiss. Ergebnisse der Schwed. Exp. Magellanländern, 1895–7, Bd. iii. pp. 59–64.

Nikitinsky, Jacob—**Ueber die Beeinflussung der Entwickelung einiger Schimmelpilze durch ihre Stoffwechselprodukte.** (On the influence exerted on some mould-fungi by the products of their metabolism.)
Inaug. Diss. Basel. Leipzig, 1904, 8vo, 93 pp.
See also *Centralbl. Bakt.*, xiii. (1903) pp. 773–4.

Orton, W. A.—**Plant diseases in 1903.**
[The different cultivated plants are recorded, with the parasites that have been found attacking them.]
Yearbook, U.S. Dep. Agric., 1903 (Washington, 1904) pp. 550–5.
See also *Centralbl. Bakt.*, xiii. (1904) pp. 655–6.

PATOUILLARD, N.—**Contribution à l'histoire naturelle de la Tunisie. Notes Mycologiques.** (Contribution to the natural history of Tunis. Mycological notes.)
[Several new species of fungi are described, and important critical notes are made on others.]
Extr. Bull. Soc. Hist. Nat. d'Autun, xvii. (1904) pp. 1–15 (pls. iii.–v.).
See also *Hedwigia*, xliv. (1904) Beibl., p. 17.

REHM, H.—**Ascomyceten exs. fasc. 33.**
[A list of the species included in the Exsiccata, with notes on some of the plants, and diagnoses of those that are new.]
Ann. Mycol., ii. (1904) pp. 515–21.

" " **Revision der Gattungen Tryblidiella, Rhydithysterium, Tryblidaria, Tryblidium, Tryblidiopsis.** (Revision of the genera *Tryblidiella*, etc.)
[The writer considers that the species of *Rhydithysterium* should be included under *Tryblidiella*.]
Tom. cit., pp. 522–6.

" " **Ascomycetes Fuegiani, A P. Dusen collecti.**
[Several of the species collected are new; descriptions of these are given.] *Wiss. Ergeb. der Schwed. Exp. Magellan.*, 1895–7, pp. 39–58 (1 pl.).

" " **Beiträge zur Pilzflora von Südamerika. XIV.** (Contributions to the fungus-flora of South America, collected by E. Ule in Brazil.)
[There is a large number of new species of microfungi; the new genera are *Trycophyma* (Myriangiales) and *Stictoclypeolum* (Mollisiaceæ.)] *Hedwigia*, xliv. pp. 1–13 (1 pl).

ROLLAND, LÉON—**Observations sur quelques espèces critiques.** (Observations on critical species.)
[The author gives descriptive and explanatory notes on some of the larger Hymenomycetes.]
Rév. Mycol., xxvi. (1904) pp. 137–41.

" " **Champignons des îles Baléares, récoltés principalement dans la région montagneuse de Solier.** (Fungi of the Balearic Isles, collected chiefly in the mountainous region of Solier.)
[The author sketches the locality, and makes notes on some of the parasitic forms; the list includes three new species.] *Bull. Soc. Mycol. France.* xx. (1904) pp. 191–210 (2 pls.).

STIRLING, JAMES—**Notes on a census of the Flora of the Australian Alps.**
[The list includes a number of lichens and fungi, recorded on pp. 391–5.]
Trans. and Proc. Bot. Soc. Edinb., xxii. (1904) pp. 319–95.

SYDOW—**Mycotheca germanica, Fasc. V.–VI.** (Nos. 201–300.)
[Diagnoses are given of a number of the species, some of them new to science.]
Ann. Mycol., ii. (1904) pp. 527–30.

TROTTER, A.—**Notulæ mycologicæ.** (Mycological notes.)
[The notes deal largely with new species of microfungi.]
Tom. cit., pp. 533–8 (4 figs.).

TUZSON, JOHANN—**Ueber das Modern und die Konservierung des Buchenholzes.** (The decay and preservation of Beech wood.)
Budapest: Lex-Okt., 90 pp., 3 col. pls. and 16 figs. (Hungarian.)
See also *Hedwigia*, xliv. (1904) pp. 31–2.

Lichens.

Notes on Lichens.*—James McAndrew gives popular notes on Lichens in general—on their form, classification, habitat, and on their

* Trans. Edinb. Field Nat. Club and Micro. Soc., v. part 2 (1904) pp. 86–94.

economic uses as dye-stuffs or as food. He then gives a more particular description of *Cladoniæ*. He recognises three genera, *Pycnothelia*, *Cladonia*, and *Cladina*, which most lichenologists include under one genus, *Cladonia*. He pronounces against the theory of a symbiosis between Fungi and Algæ as an explanation of the Lichen thallus, and strongly advocates the use of reagents as an aid in the determination of species.

Habitat of Lichens.* — W. West publishes a note on *Physcia parietina*, which had been recorded by Wheldon and Wilson as growing with great luxuriance on cow-sheds. His own observations agree with those of these two collectors, and he considers that the presence of nitrogenous matter—which would be conveyed as dust to the roof of such buildings, to walls on road-sides, etc.—probably accounts for the presence of this lichen in these situations. Maritime rocks are another favourite habitat, the desired nourishment being supplied by the droppings of sea-birds.

Anatomy of the Genus Usnea.†—Fritz Schulte has carefully worked through several species of this genus, and gives the histology of the thallus and the apothecia. The fibrils, he finds, repeat the anatomy of the main axis; a strong sclerotic central axis is characteristic of all the forms. This strand is repeated in the fruits as a sub-hymenial layer. The cortex is formed of parallel hyphæ. In the young fruits he found the ascogones, but, with the exception of one very doubtful case, he found no trichogyne. Schulte tested also for chemical properties. Barbatin acid was present in large quantities in *Usnea ceratina*, sparingly in *U. longissima*. It was absent in all the other species examined. Usnea acid was found only in *U. microcarpa*, *U. Schraderi*, *U. cornuta*, *U. scabrata*, *U. plicata*, and *U. dasypoga*. It forms a red colour with potash; crystals of calcium oxalate were deposited on the hyphæ of all the species examined.

MALME, GUST. O. A. N.—**Beiträge zur Stictaceen Flora Feuerlands und Patagoniens.**
[A short account of the family, and a list of species collected by the Svenska expedition in Fuegia and Patagonia.]
Wiss. Ergebnisse der Schwed. Exp. Magellanländern. 1895–97, Bd. iii. (1904) pp. 1–37 (2 pls.).

NILSON, B.—**Die Flechtenvegetation von Kullen.** (Lichen vegetation of Kullen.)
[The character of the country is described, and a list of 187 species is given, none of them new; there are some important notes and descriptions of the lichens.]
Arkiv f. Bot., i. (1904) pp. 467–96.
See also *Hedwigia*, xliv. Beibl., p. 18.

OLIVIER, H.—**Lichens du Kouy-Tchéou.**
[The writer describes seven *Cladoniæ* and one *Physcia* from the district.]
Bull. Acad. Intern. Géogr. Bot., 3 sér., xiii. (1904) No. 183, pp. 193–6.
See also *Ann. Mycol.*, ii. (1904) p. 560.

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* Journ. Bot., xliii. (1905) pp. 31–2.
† Beih. Bot. Centralbl., xviii. (1904) pp. 1–22 (8 figs. and 3 pls.).

Schizophyta.

Schizomycetes.

Identity of Loeffler's Bacillus typhosus murium with the Bacillus paratyphosus "B." *—Bonhoff considers that the *Bacillus typhosus murium* of Loeffler, the *B. enteriditis* of Gaertner, and the *B. paratyphosus* "*B*," are to be differentiated neither biologically nor by their agglutinating and bacteriolytic reactions, but there exist certain differences of pathogenic properties, the exact nature of which have, as yet, not been explained. However, the three organisms belong to one group, and are far more nearly related to each other than the *B. paratyphosus* "*B*" is to the *B. paratyphosus* "*A*," to which latter organism he suggests the name paratyphosus should be restricted.

Red String of the Sugar Cane.†—R. Greig Smith examined an example of red string in an apparently healthy cane which had only two or three coloured bundles in cross section. Portions of the red strings were cut out with a sterile knife and inserted into tubes of molten glucose-gelatin, which after standing for an hour or two at 30° C. were poured into Petri dishes. He obtained a mould which produced a brilliant crimson scarlet colour, and was primarily responsible for the colour of the strings, and also several bacteria. From the presence of gum in the vessels he was of opinion that the mould was accompanied by a slime bacterium, and that the complete phenomenon of red gum was brought about by the simultaneous growth of two organisms, a mould and a bacterium. Of the bacteria isolated, one was a slime bacterium, another was *B. sacchari*, and a third was *B. fluorescens liquefaciens*. To test which of these would produce a crimson colour when grown in combination with the mould, he planted a fragment of the mould upon the centre of a plate of nutrient lævulose agar, on which medium it only produced a trace of colour. "When the mould had grown outwards as a zonate white pile of about 3 c.cm. diameter, the bacteria were infected at three places equidistant from the centre. In three days giant colonies had formed at the points of infection, while the mould had spread towards them. As the mould touched the white slime bacterial colony, a brilliant crimson colour developed not only throughout the colony but in the neighbouring medium." The *B. sacchari* developed a foxy red colour, but the mould refused to grow towards the colony of *B. fluorescens liquefaciens*. This experiment showed that the white slime bacterium could be of service to the mould in producing the colour of the crimson red gum in the vessel of the cane. The bacterium grew as a white slime on sterile sugar cane, and the mould grown on the same medium produced "practically" no colour. When both bacterium and mould were grown together, a deep crimson colour was developed. He found the gum to be a galactan, giving the chemical reactions of arabin; he named the bacterium *B. pseudarabinus*. It is an actively motile coccobacillus, with numerous flagella; it stains readily, but not by Gram's

* Centralbl. Bakt., Ref. 1te Abt., xxxv. (1904) p. 763.
† Proc. Linn. Soc. N.S.W., 1904, pp. 449–59.

method; spore formation was not observed. He gives details of the cultural characteristics of this organism, and also a short account of the morphology and life history of the mould, which, however, he cannot identify with any hitherto described fungus.

Bacillus subtilis group of Bacteria.*—F. D. Chester reviews the researches of Gottheil and of Meyer, which show the value to be placed on the morphological rather than on the cultural characters in making a classification of this group of bacteria.

The members of this group are arranged in two classes: (*a*) those whose diameter is less than one micron (μ), *B. mesentericus*, *B. asterosporus*, *B. subtilis*, *B. simplex*, and *B. fusiformis*; (*b*) those whose diameters exceed one micron, *B. ruminatus*, *B. cereus*, *B. mycoides*, *B. tumescens*, and *B. megatherium*.

The principal value of measurements applies to the sizes of spores, which are more constant; three sizes are included: (*a*) spores $0 \cdot 5\ \mu$–$0 \cdot 6\ \mu$ in diameter, *B. mesentericus*; spores with an average diameter of $0 \cdot 8\ \mu$, *B. cereus*, *B. tumescens*, and *B. fusiformis*; spores of $1 \cdot 0\ \mu$–$1 \cdot 6\ \mu$ diameter, *B. megatherium*, *B. ruminatus*, and *B. asterosporus*.

Spores are further differentiated by their form and by the character of their walls. Five different forms are noted: (*a*) reniform spores of *B. megatherium*; (*b*) small elongated spores of *B. mesentericus*; (*c*) quadrangular and pointed forms in *B. ruminatus*; (*d*) round spores in *B. fusiformis*, and (*e*) the oval or elliptical spores of other species.

Spores stained by his method show two distinct parts, an inner unstained central body, and an outer deeply-stained wall or membrane. In some varieties (*B. subtilis*) this wall is thin and without differentiation of parts; in others (*B. ruminatus*) it is a relatively thick capsule composed of three distinct portions, an outer deeply-staining membrane (extine), a delicate inner layer (intine) surrounding the central body, and an intermediate faintly-staining portion.

Germination in this group takes place in two ways—by protrusion, and by stretching and subsequent rupture. Spore germination is either polar or equatorial, and sometimes the germinal rod emerges from the rod from both poles, the spore membrane remaining attached to the rod as a ring (*B. simplex*). When the germinal rod emerges from the spore it enters the "vegetative" stage; these vegetative rods undergo septation, forming shorter vegetative cells, and these, again, produce short and long chains or individual swarms. The duration of the swarming stage and the character of the motility have an important bearing on the differentiation of these organisms, and also on certain cultural characteristics. The vegetative and swarming stages are followed by the production of longer vegetative rods, and their separation as individual cells whose special function is to produce spores. These specialised cells have been termed "sporangia." He gives details of the cultural features and chemical functions of the group, and appends a classification.

Bacillus fusiformis.†—V. Ellermann has isolated this organism on two occasions—from a fatal case of necrotic stomatitis, and from a

* Centralbl. Bakt., 2te Abt., xiii. (1904) pp. 737–52.
† Op. cit., 1te Abt., xxxvii. (1904) p. 729.

case of ulcerative angina. Colonies of 1–1·5 mm. appeared, after two days, in the depth of serum agar; they had a felty, branched appearance, and when fully grown were often prismatic in shape, of a pale yellow colour, and smelling offensively; the medium became clouded but was not liquefied; growth was only obtained under anaerobic conditions; in serum broth there formed, after 24 hours, large white flocculi, which sank to the bottom; no growth was obtained on ordinary agar, glucose agar, Hesse's agar, or on ordinary broth.

The bacillus is a non-motile, slender rod, with pointed ends and faintly and irregularly staining protoplasm; in length about 5 μ–12 μ, and at times forming very long threads; it stains by Gram's method and by Weigert's, but not by that of Claudius; it contains no Babes-Ernst granules. The author refers to the similar organisms isolated by Veillon and Zuber, and also to Vincent's bacillus.

Septicæmia affecting Geese.* — Riemer gives details of two epidemics of septicæmia occurring among geese. From the blood of these cases, taken after death, he isolated an organism, identical in each case, which resembled the bacillus of swine erysipelas. It consisted of fine rods 0·3 μ – 1 μ long and 0·1 μ broad, two being often linked together end on; in agar and broth cultures abundant threads are seen; after several days' incubation only coccal forms are found; these stain well and simulate contamination. The bacillus stains by ordinary aniline dyes but is decolorised by Gram; it is non-motile, and flagella are absent; spore formation not observed. Growth is good on faintly alkaline media; slight acidity hinders, and strong acidity completely stops growth; the cultures are relatively short lived, 14 days' to 3 weeks' incubation killing the rods, so that frequent subculture is necessary; the optimum temperature is 37·5° C. Gelatin is not a favourable medium, growth showing on the surface after 2 or 3 days, as small depressions, in which, under microscopic examination, are seen to lie small, smooth-edged, yellow colonies with finely granular surfaces; in gelatin stab cultures, growth occurs only at the surface, and after a week the gelatin is almost entirely liquefied, and has a slimy consistence in which floats a white soft bacterial mass. In agar stab, growth takes place only at the upper part, and, on the surface broadens out as a delicate pellicle. Broth cultures are clouded, and in some cases a pellicle is formed which consists of long interlacing threads; in other cases no pellicle is formed. In milk and in glucose broth there is a similar growth; no change of reaction occurs in the milk, nor is it coagulated; in the glucose broth there is a slight addition of alkali, but no gas production; there is no growth on potato. Growth is best on Loeffler's blood serum, forming yellowish white colonies; the bacilli are larger and stronger than on other media, and the above mentioned double forms rarely occur; later the medium is stained brown, and slightly liquefied. A 24 hours' old culture was killed by exposure to 56° C. for 5 minutes. Riemer found the organism was pathogenic if injected into geese, but not so if given with the food; it was less pathogenic for ducks, and innocuous to fowls and pigeons and to the ordinary experimental animals.

* Centralbl. Bakt., 1te Abt., xxxvii. (1904) pp. 641–8.

Glischrobacterium as the Cause of Mucous Fermentation of Urine in Man.*—E. A. Rothman records a case of ropey urine in a man. The urine, which resembled glycerin, was straw coloured, slightly cloudy, of acid reaction, and sp. gr. 1·006; it contained a trace of serum, albumin, and mucin, and showed 40–60 leucocytes to a microscope field.

Stab cultures in agar, after 24 hours at 36° C., gave abundant growth of mucous masses; on agar plates the confluent colonies formed worm-like figures; examined microscopically, the younger colonies were finely granular, round with smooth edges, and of a yellowish brown colour; the older being coarsely granular, and having indented edges. Smear preparations showed short rods 0·7 μ–1·5 μ long by 0·3 μ–0·5 μ broad, imbedded in mucus. They stained best by Ziehl's carbol-fuchsin well diluted with a 3 p.c. solution of carbolic-acid water, and also by Gram's method. Hanging drop of broth culture showed active molecular movement, and slight true motility. Stab culture on gelatin showed growth along the stab, but mostly on the surface, gas being produced in the depth of the medium; the gelatin was not liquefied. Anaerobic cultures grew more slowly. The optimum temperature was 36° C. Broth, milk, and 2 p.c. pepton solution in 0·85 p.c. sodium chloride, became ropey like the urine, the broth becoming slightly clouded, and having a copious sediment; no pigment was formed. A faint indol reaction was obtained. Growth was scanty on serum. The organism was very sensitive to drying. It was only very slightly pathogenic for animals.

Rothman considers that this organism is the same as that described by Salaris and Malerba, and named by them the *Glischrobacterium*; but he failed to obtain growth on potato, and the appearance of the colonies on solid media is not quite the same as that observed by these authors.

He refers to three published cases of ropey urine, and suggests the comparison of this mucous fermentation with that noted by Pasteur as occurring in wine—"*vin filant*"—produced by the *Micrococcus viscosus*, and that noted by Van Laer as occurring in beer; also the mucous fermentation of milk described by Adametz, produced by *Bacillus lactis viscosus*, and to similar conditions recorded by other writers.

Pathogenic Capsulated Streptococcus from the Naso-pharynx.†R. O. Neumann has found on eight occasions capsulated streptococci in the nasopharynx. They are characterised by their clear, glass-like, water-drop, transparent colonies on gelatin and agar, and by their well-formed capsules and the large size of the individual cocci. Two or four cocci are seen lying together in one capsule; chains occur rarely; the cocci are usually round, but sometimes oval, or rod-like; some strains stain by Gram's method, others do not; the capsule stains slightly or not at all by ordinary aniline dyes. Good growth is obtained on agar, gelatin, glycerin-agar, and sugar-agar, but Loeffler's serum is unfavourable to growth. The colonies are sharp contoured, about the size of a pin's head, and resemble small drops of saliva; with low magnification they show a homogeneous, finely-granulated substance, readily drying up in the course of a few days; in broth there is slight cloudiness without

* Centralbl. Bakt., 1te Abt., xxxvii. (1904) pp. 491–5.
† Tom. cit., pp. 481–4.

much sediment; on potato, growth is variable—with some stains it is only slight, with others it is good, resembling that of *B. mucosum*; milk usually coagulates after many days, a later peptonising of the coagulum rarely happens; gas production, H_2S formation, and indol reaction were not observed; gelatin was not liquefied. Growth was equally good under anaerobic and under aerobic conditions. The various strains were pathogenic for white mice, guinea-pigs, rats and rabbits, and were equally toxic by subcutaneous and intraperitoneal injection, death occurring usually after 2–4 days, according to the dose administered. The author refers to several varieties of similar organisms described by other writers, and indicates where these differ from that isolated by himself.

Variable Galactan Bacterium.*—R. Greig Smith isolated a slime bacterium from *Strychnos Atherstonei*; it grew on gelatin plates as almost powdery colonies, lying on the surface of the medium and breaking into fragments when touched with a needle. Pure cultures were prepared by repeated cultivation on glucose-gelatin plates. The pure cultures infected into saccharose pepton fluid produce slime. The slime was also formed from other carbohydrates, especially maltose and glycerin, and to a slighter extent from galactose, lævulose, dextrose, lactose, and invert-sugar; the production of slime being measured by the viscosity, which is determined by noting the time in seconds during which 5 c.cm. of the culture passed through a pipette with a capillary orifice. The author employed the glycerin medium for the production of large quantities of the gum; this on analysis he found to be a galactan.

On cultivation, the bacterium was observed to take on a modified type, with the formation of yellow, slimy colonies on glucose gelatin; this depends on an alteration of the solubility of the gum. He has named the organism *Bacillus Atherstonei*. Morphologically, it occurs as plump, round-ended rods, $1\cdot2\,\mu$ by $0\cdot7\,\mu$–$0\cdot8\,\mu$, and in saccharose pepton-fluid threads up to $7\cdot5\,\mu$ may be formed. The bacillus is motile, but flagella could not be stained; it is non-sporing; it does not stain by Gram's method; it grows at 30° C., but gum or slime is only produced at or below 22° C. Details of the cultural characteristics on various media are given.

Epidemic Cerebrospinal Meningitis and its Specific Cause.†—A. Bettencourt and C. Franca have studied bacteriologically 271 cases of cerebrospinal meningitis, and in all, with three exceptions, they found the *Micrococcus intracellularis meningitidis* of Weichselbaum.

Material for the research was obtained by lumbar punctures and from the cerebral ventricles after death. Ascitic agar and broth, to which cerebrospinal fluid had been added, were used as media. In six cases cultures were made from venous blood, but they all remained sterile. Direct examination of cerebrospinal fluid showed in acute cases a preponderance of polymorphonuclear leucocytes; in protracted cases these were replaced by lymphocytes and mononuclear cells. Inside

* Proc. Linn. Soc. N.S.W., 1904, p. 442.
† Centralbl. Bakt., 1te Abt. Ref., xxxv. (1905) pp. 769–71.

and outside the cells were diplococci resembling Neisser's gonococcus, staining with aniline dyes, but not by Gram's method. Broth cultures were uniformly clouded, and often formed a pellicle; on ascitic agar after 24 hours, greyish-white, translucent shining colonies appeared, having round wavy margins and more opaque centres, which later became yellow and brown, whilst on the margins a characteristic crystalline deposit was noticeable; on ordinary agar growth was slower, on potato hardly visible; on sloped agar cultures with neutral red and glucose it took on a pale pink colour, the medium remaining unchanged; growth was good in milk, but coagulation did not occur; no growth was obtained on gelatin at 18°–22° C.; the diplococcus only grew in the presence of oxygen; indol reaction and Legal-Weil's test were negative; addition of glycerin to the media inhibited growth. For animals this diplococcus was found to be only slightly pathogenic. Serum from a patient suffering from cerebrospinal meningitis agglutinated the diplococcus—the authors regarding this as a specific reaction.

Bacterium cyaneum: a New Chromogenic Organism.† — E. L. Leonard describes a micro-organism that was discovered on several occasions in air plates made in the Hendrix Laboratory during 1900–1901, but has not been again met with. The colonies of this bacterium are remarkable for the deep blue pigment they produce in the surrounding medium. It is a non-pathogenic chromogenic bacillus $1\,\mu$–$2 \cdot 5\,\mu$ in length, $0 \cdot 7\,\mu$ in thickness, longer forms appearing in broth cultures. It is non-motile. It contains refractile deeply staining granules, but no spores, capsule or flagella have been observed; it stains by the ordinary aniline dyes, and also by Gram's method. Growth is best at room temperature; it grows well at 37° C., but does not form pigment; at 10° C. no growth occurs; it is killed by 5 minutes' exposure to moist heat of 68° C.; no growth occurs under anaerobic conditions. On agar plates at 37° C., 24 hours old, colonies are coarsely granular and greenish-yellow in colour, the older colonies having thin irregular edges; in those growing at room temperature, many fine, irregular, blue granules occur throughout the central portion of the colony, the surrounding medium being lightly tinged blue. On gelatin plates, 24 hours old, colonies are small, granular, brownish-yellow, with circumscribed edges; the medium is unchanged, but liquefaction commences after 48 hours, and is complete in 3–4 days, the medium becoming slightly greenish-yellow in colour. Litmus milk shows no change within 36 hours; after 48 hours it becomes more alkaline, and at the 4th–5th day it is decolorised, but remains uncoagulated, the organism forming a blue precipitate at the bottom of the tube. Growth on potato appears only after 3–4 days. On blood serum a yellow-green growth is seen after 24 hours; it is elevated and moist; there is a slight blue coloration of the medium, which, after a week, becomes liquefied and of an olive-green colour. Fermentation tests in dextrose-free bouillon show no gas formation, nor is gas produced in any sugar solution.

† Johns Hopkins Hosp. Bull., xv. (1904) p. 398.

The blue pigment is non-crystalline, soluble in water, slightly in alcohol, insoluble in ether and chloroform.

The author sets out in tabular form the differentiating characters between this organism and *Pseudomonas cyaneo-fluorescens* and *Pseudomonas syncynea*.

BEIJERINCK, M. W.—**Ueber die Bakterien welche sich im dunkeln mit Kohlensäure als Kohlenstoffquelle ernähren können.**
Centralbl. Bakt., 2te Abt., xi. (1904) pp. 593–9.

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Op. cit., 1te Abt., Ref., xxxv. (1904) pp. 1–15.

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Tom. cit., pp. 533–5 (1 pl.).

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Op. cit., xi. (1904) pp. 721–3.

HEFFERAN, MARY—**A Comparative and Experimental Study of Bacilli-producing red pigment.** *Tom. cit.*, pp. 520–40.

HILL, G. E.—**Bacterial Disposal of Sewage.**
Journ. Franklin Inst., clix. (1905) pp. 1–16.

KAMEN, L.—**Zur Ætiologie der Gasphlegmone.**
Centralbl. Bakt., 1te Abt. Orig., xxxv. (1904) pp. 554–63, 686–714 (3 pls.).

MENEL, EM.—**Einige Beobachtengen über die Struktur und Sporenbildung be symbiotischen Bakterien.** *Op. cit.*, 2te Abt., xii. (1904) pp. 559–74 (1 pl.)

NEIDE, E.—**Botanische Beschreibung einiger sporenbildenden Bakterien.**
Tom. cit., pp. 539–54 (3 pls.).

OTTOLENGHI, D.—**Ueber die feine Struktur des Milzbrandbacillus.**
Op. cit., 1te Abt. Orig., pp. 546–53 (3 figs.)

PREISZ, H.—**Studien über Morphologie und Biologie des Milzbandbacillus.**
Tom. cit., pp. 537–45, 657–65 (2 pls.).

SCHORLER, B.—**Beiträge zur Konntniss der Eisenbakterien.**
Op. cit., 2te Abt., xii. (1904) pp. 681–95.

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[An experimental study, with descriptions of the cultures and the technique. employed.] *Bureau Govt. Lab. Manila, Publication* 16, (1904) 52 pp.

SÜCHTING, H.—**Kritische Studien über die Knöllchenbakterien.**
Centralbl. Bakt., 2te Abt., xi. (1904) pp. 496–52.

VEJDOVSKÝ, F.—**Ueber den Kern der Bakterien und Seine Teilung.**
Tom. cit., pp. 481–96 (1 pl.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Ladd's Student's Microscope.—This instrument (fig. 34), kindly presented to the Society's Collection by Mr. Wynne E. Baxter, was exhibited at the Meeting on May 18, 1904. It was made about 1864. Its features are: a very light tripod foot, consisting of a framework of tubes; a body fixed on a frame, which slides on a straight dove-tailed bar, on the Jackson plan; the substage slides on the same bar, and is movable by rack-and-pinion, whilst the stage, which is also fitted in the same dove-tailed groove, is fixed.

Motion is not imparted to the body by rack-work, but by a chain working round a spindle turned by the milled head, which gives a movement of remarkable smoothness and free from backlash. A part of the chain is visible in the figure, above the top of the dove-tailed bar.

The fine-adjustment is made by a lever which hangs down from a collar formed on the right-hand milled head of the coarse-adjustment.

The mechanical stage is also moved by chains in both directions.

The substage referred to is peculiar, and consists of two movable plates carried by a third plate which is fixed to a bracket that slides in the dove-tailed groove already mentioned.

The centring of the substage is effected by means of the two movable plates. The upper plate is pivoted on the lower, and the latter is pivoted on the fixed plate. The pivot of the upper plate is seen in the figure, to the right of the tube for receiving the condenser. The pivot of the lower plate is to the front of the tube, and is hidden by the upper plate. Motion is given to each plate by means of a pinion geared into a short rack cut in the edge of the plate near the corner. The pinion and milled head for moving the lower plate are seen in the figure, and the pinion for moving the upper plate is in a corresponding position on the other side. Owing to the positions of the pivots, the movements of the plates are at right angles to one another, so that the condenser can be adjusted to the axis of the instrument.

The mechanical stage is moved in both directions by chains passing round spindles.

There are two eye-pieces and two object-glasses, of 1 in. and ¼ in. focus.

This Microscope is described in Carpenter, 4th edition, 1864.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Portable Microscope. — This instrument (fig. 35) — presented by Dr. C. St. Aubyn-Farrer, May 18, 1904—though probably by Cary, is

FIG. 34.

without the maker's name, and is similar to that made by Cary, after the design of C. Gould, about 1828.

This Microscope differs from the one in the Society's Collection

in having an eye-piece with two lenses only, instead of three, although the presence of a screw-thread seems to indicate that provision for this third lens had been made, which, however, is not essential for the production of a good image.

The spring-clip to the stage is fixed on the upper side, instead of the under side—a much better position.

The mirror is plane, and under $\frac{11}{16}$ in. in diameter (less in diameter

FIG. 35.

than a sixpence). It can be used for illuminating opaque objects by inserting the stem in the socket seen to the right-hand of the stage.

The object-glasses are three simple lenses, which may be used singly or in combination. By removing the body the instrument can be used as a simple Microscope.

Zeiss's New Laboratory Stand.*—This instrument (fig. 36) is intended for use in the laboratory, and for demonstration purposes. One

* rl Zeiss's Special Catalogue, x. (1904).

of its chief features is an obvious and convenient handle, a most useful adjunct to an instrument intended for elementary microscopists who are prone to lift the stand by its fine-adjustment. The instrument is supplied with rack-and-pinion coarse-adjustment, and a micrometer movement fine adjustment. The fixed stage is circular, and of large dimensions (4⅝ inch diameter), but this may be easily removed and replaced by a rotating stage, provided with a scale of degrees whenever polarised light is required. The usual accessory substage fittings and

FIG. 36.

apparatus are supplied. Their addition adds somewhat to the cost, but materially increases the effectiveness of the instrument.

Reichert's New Large Stand, A 1, with Extra Wide Tube and New Lateral Micrometer-screw.* — In this instrument (fig. 37) the body-tube projects specially far over the stage, and permits of the examination of large plate preparations or Petri's dishes. The pillar can be used as a handle without danger of disturbing the fine-adjustment. The circular rotating stage can be centred by means of the screws *c c'*, which also provide a small lateral movement. Larger movements up to 100 mm. may be obtained by means of a new mechanical stage, which

* C. Reichert (Vienna), Catalogue No. 25 (Mikroscopie, 1904) pp. 14–15.

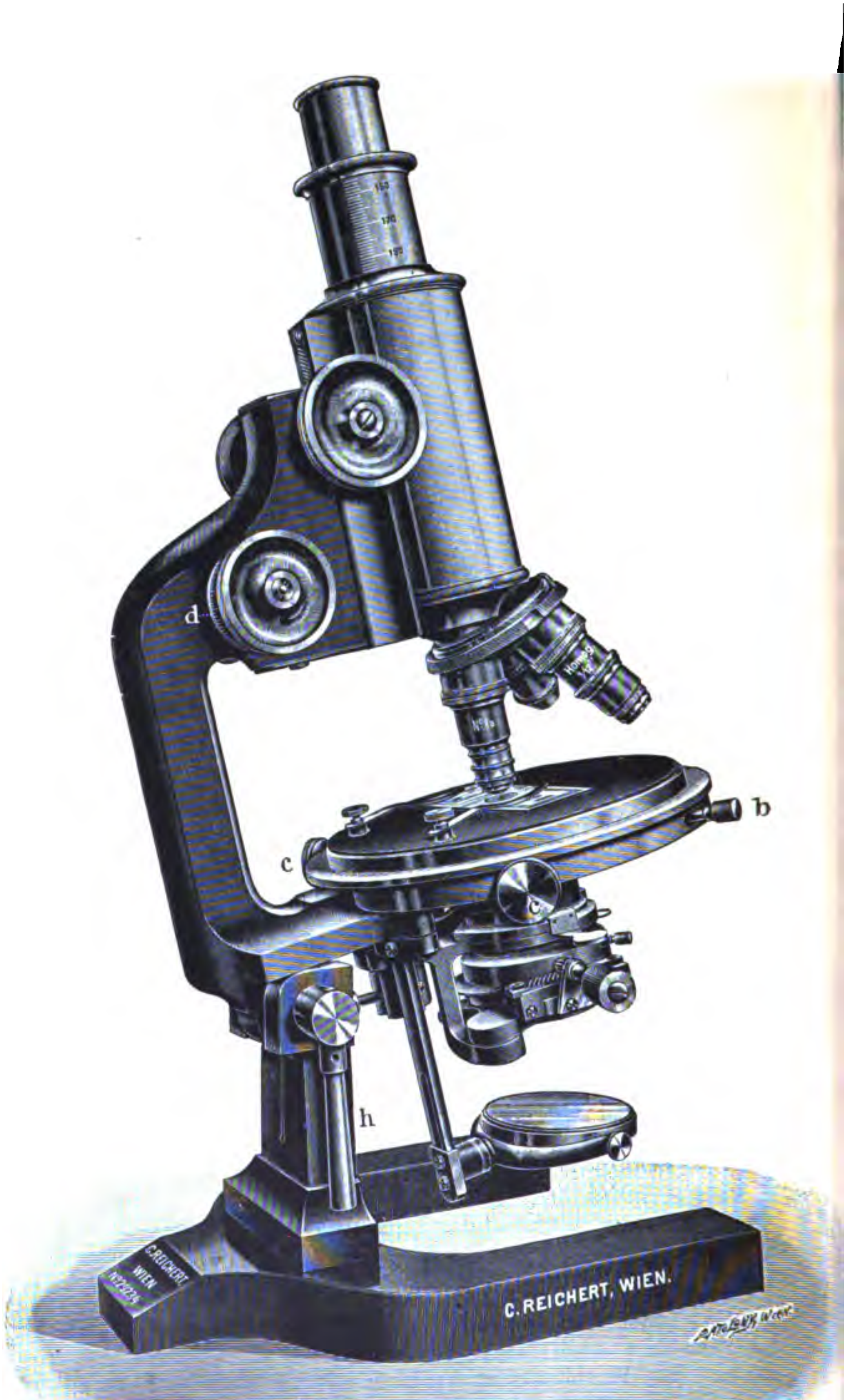

FIG. 37.

can be fitted above the rotating stage. The coarse-adjustment is by rack-and-pinion. The fine-adjustment (fig. 38) is by means of a new micrometer-screw, which operates thus: by turning the milled head *m* a spindle on which a worm is cut actuates a worm-wheel, by the rotation of which a roller is raised or lowered, and with it the tube. In this manner a fine-adjustment of the greatest delicacy is attained. The movement of the micrometer-screw is an endless one, which is a feature of considerable importance. Since the only downward pressure is that of a delicate spring and the slight weight of the aluminium tube, the resistance to the micrometer-screw is exceedingly small, and injury to the

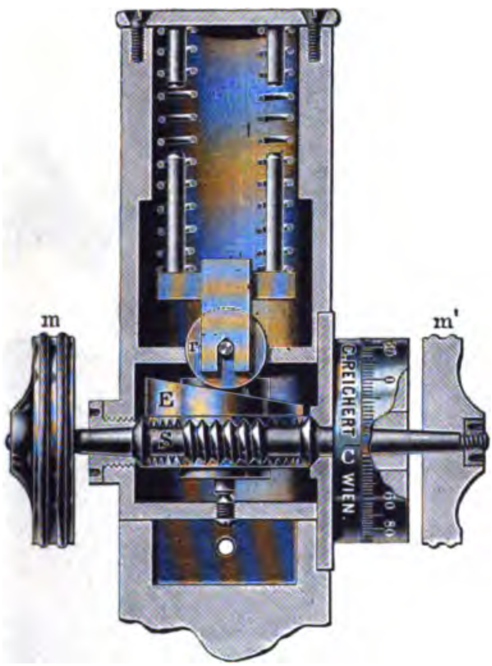

FIG. 38.

cover-glass is almost impossible, even should the objective come into contact with it. All bearing surfaces are of steel, and the entire mechanism is protected within the frame of the Microscope. The head of the micrometer-screw is so graduated that one division is equivalent to 0·001 mm. movement of the objective.

Reichert's Large Stand, No. 1 A, fitted with Tip-up Stage-Clips.* The movable object-stage of this instrument (fig. 39) was figured and described in the Journal for 1898 (p. 383, fig. 43), but attention was not called to the tip-up stage-clips, which are here seen in position.

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) pp. 17–18 (figs. 4, 4*a*).

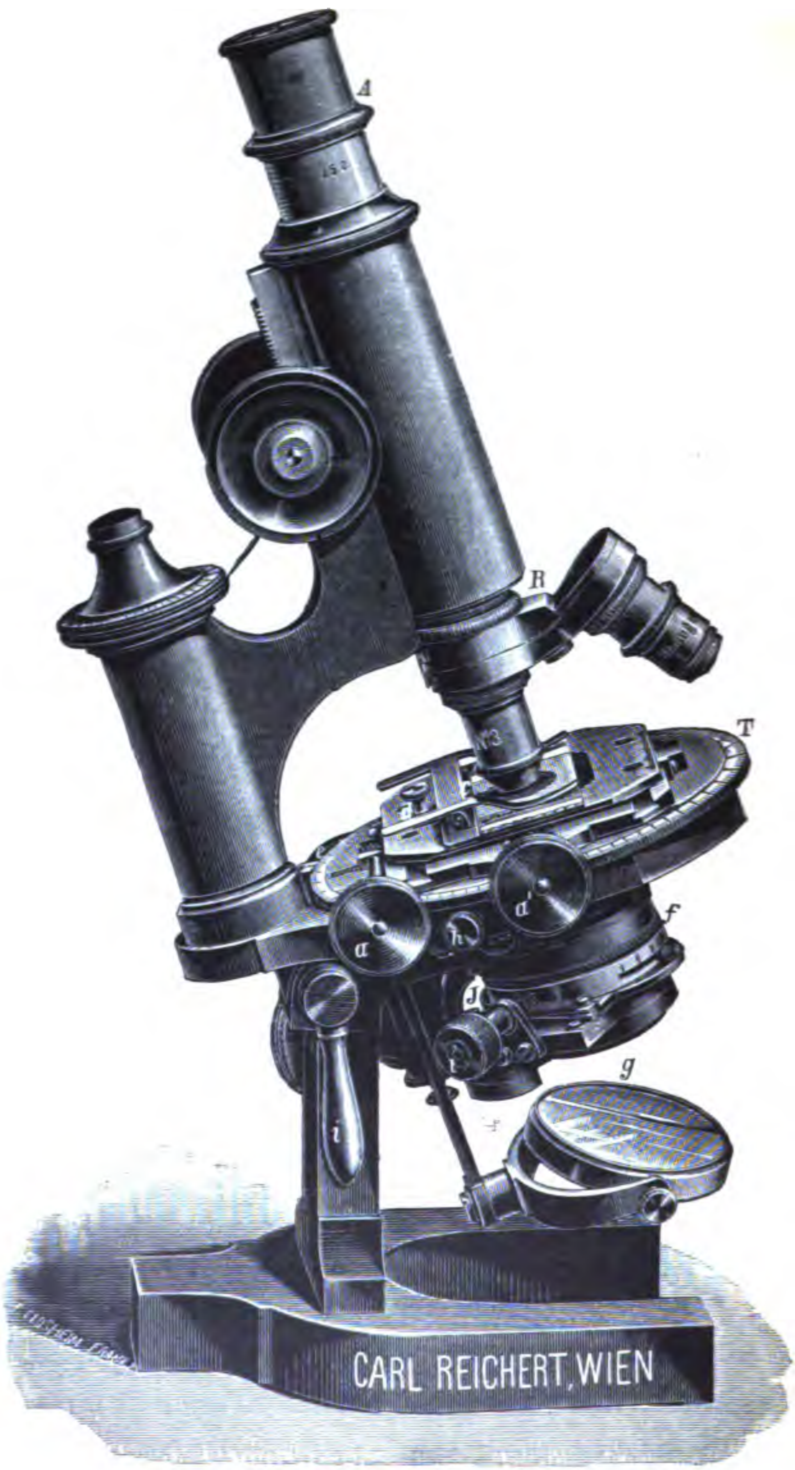

Fig. 39.

Reichert's New Mineralogical Stand.*—This instrument (fig. 40) is similar in size and adjustment to the last described model. The

FIG. 40.

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) p. 30, fig. 16c.

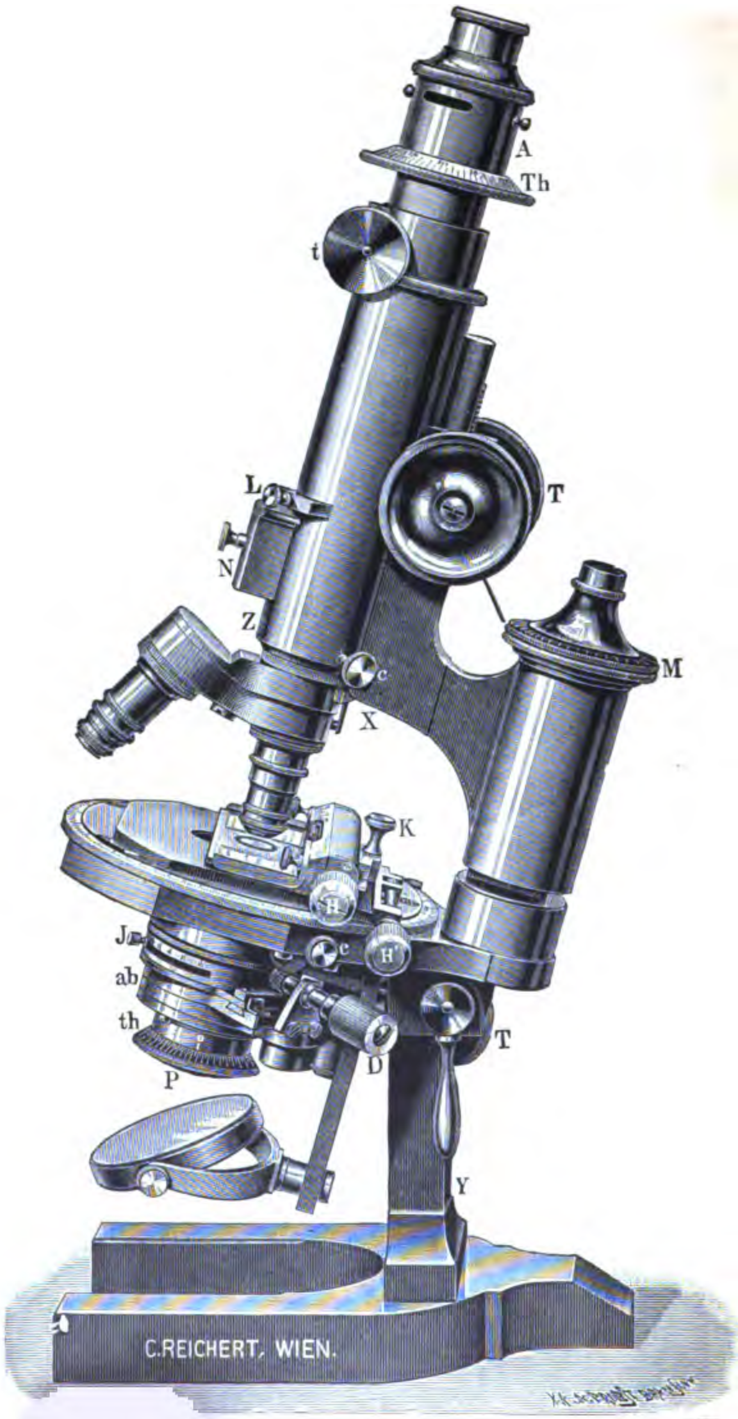

Fig. 41.

object stage is completely rotatory around the optic axis, and has also rectangular movements—one with slow micrometer adjustment, readable to 0·01 mm., the other with quicker movement, readable to 0·1 mm. The circular graduations are into 360° with a vernier. The rotatory object-stage, by lifting the fixing screws at its sides, can be removed and replaced by a vulcanite stage with a finding arrangement, and is likewise graduated into 360°. The micrometer-screw has a vernier; the third Nicol is rotatory for about 90° in a collar within the tube; there is a Bertrand condenser.

Reichert's Large Mineralogical Stand.*—This instrument, catalogued as No. 1 *b*, is shown in fig. 41, and is made with a rotatory object-stage, divided into 360°, and crossed by two millimetre scales at right angles for orientating known objects. The mirrors are hollow-plane, and adjustable at various heights. The coarse-adjustment is by rack-and-pinion, and the fine by a new delicate graduated micrometer-screw. Both polariser and cylinder-diaphragm have a vertical rack movement, and are fitted into a diaphragm-carrier of Abbe's complete illuminating apparatus, in order to afford a rapid change from polarised to unpolarised light. The analyser is placed above the ocular, and is fitted with a graduated circle divided into 360°. It has also an opening for the insertion of a quartz prism, and can be removed and replaced without disturbing the ocular. The polarising Nicol is easily rotatory, and the four quadrants of rotation are indicated by the clicking of a spring. The third Nicol, without any interference with the adjustment of the instrument, can be applied as an analyser immediately above the objective. The application of a pin ensures that the cross-threads, ocular, and the graduated circle are always in connexion. The screws *c c'* are for accurately centring the objective. Nicols with large field of view, or quartz plates, can be inserted at Z. A condenser facilitates the observation of axial images of mineral sections. By drawing out the lens L the rays through the objective can be changed from parallel to divergent pencils; the necessary draw-out adjustment of ocular is then performed by the rack *t*. The iris on the Abbe condenser receives the disks of calcite and mica.

Reichert's Microscope for Determining Hardness of Substances.†
This instrument, which has been constructed from the designs of J. A. Brinell, is shown in fig. 42. The principle of the method depends upon measuring the area in square millimetres of the circular dent produced in a substance when a superposed steel sphere is subjected to a known pressure in kilograms. The ratio of pressure per square millimetre gives the "hardness number" of the substance. The general view of the instrument is given in fig. 42, and the chief parts are:—(1) T (fig. 43) the tube forming a special Microscope, with cross-threads, ocular and objective, working up to about 50-fold magnification; (2) M, the object-stage, acting also as foot of the whole, with a pillar carrying the rotatory upper parts; (3) a horizontal arrangement of parts — some fixed, some movable — serving for the lengthwise and diagonal movements of the tube; (4) a vernier for reading off the

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) pp. 28–9, fig. 16.
† Tom. cit., p. 36, fig. 17*e*; and Special Circular.

diameter of the circular dent. The milled screw-head S provides for the vertical adjustment of the tube; S′ and S″ govern the backwards-and-forwards movement in the direction of its length; S‴ controls the

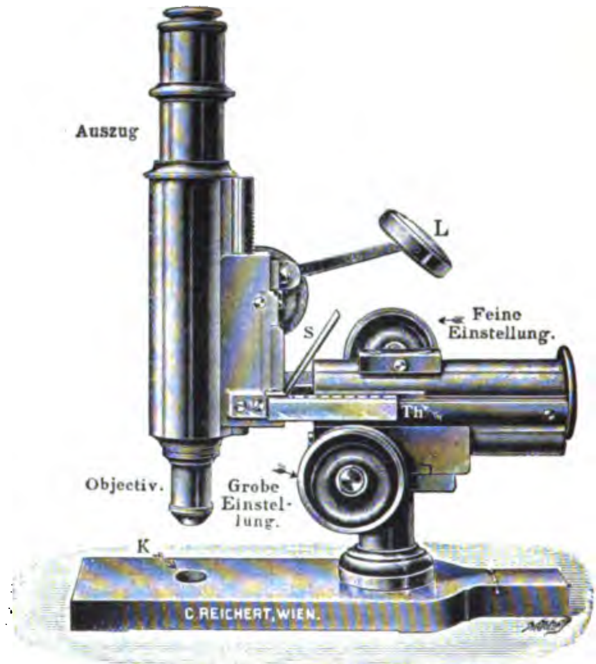

FIG. 42.

horizontal motion perpendicular to the last and moves the whole of the over-stage parts. In taking the measurements, the tube is first got upright, and the vernier by means of the screw S′ brought to the zero;

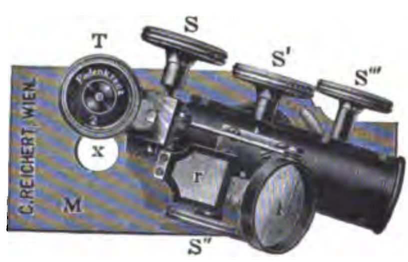

FIG. 43.

the dent to be examined is then applied to the object-stage, and the tube, by means of S″, moved so that one cross-thread is tangentially over the edge of the dent, thus ʊ. The tube is now moved sideways until the other thread (perpendicular to last) passes through the centre of the

dent. By means of S′ the tube (with the objective) is carefully moved over the dent until the first cross-thread reaches a similar tangential position on the opposite side. The reading of the vernier gives the diameter of the circular dent. A shade *r* and lens *l* are provided to facilitate reading the vernier. In the case of large objects the whole instrument is placed on the specimen so that the aperture X is over the dent.

(2) Eye-pieces and Objectives.

Reichert's Objectives with Bourguet's Spring Safety Action.*— C. Reichert has fitted this protective action to all his achromatic

FIG. 44.

FIG. 45.

objectives numbered 6 and upwards. The arrangement is shown in figs. 44 and 45. Under ordinary circumstances the elasticity of the spring keeps the combination in proper adjustment, but if there should be contact with the object, the lens-holder is pushed within its sheath.

H.—Construction of Aplanatic Combinations of Lenses with or without Achromatism. IV. *English Mechanic*, lxxx. (1905) pp. 595–6.

(3) Illuminating and other Apparatus.

Reichert's Swing-out Condenser and Iris Diaphragm.†—The complete arrangement is shown in fig. 46. It will be seen that the con-

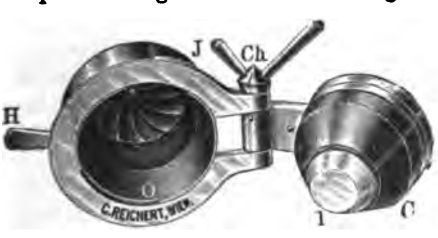

FIG. 46.

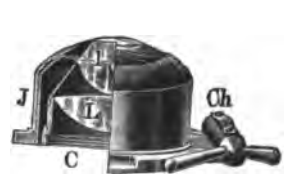

FIG. 47.

denser can be swung out of the iris by the action of the hinge *Ch*, which is operated by twisting the bifid lever. Fig. 47 shows the condenser in more detail.

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) p. 5.

Electric Warm-Stage, for Use with the Microscope, combined with a Nernst Lamp to Illuminate the Microscope.—H. C. Ross gives the following description of this apparatus (figs. 48 and 49) exhibited at the December Meeting.

"With the assistance of Engineer-Lieut. Fielder, R.N., I have invented an electric warm-stage, which has the following advantages:—(1) As it fits on top of the slide, it can be slipped on or off without altering the focus. (2) It can be used with the highest powers of the Microscope and with the Abbe condenser. (3) It does not interfere with the movements of the mechanical stage, the warm-stage moving backwards and forwards with the slide. (4) It requires no attention, for so long as the current is running through it, so long will the temperature of the centre of the slide be 37° C.

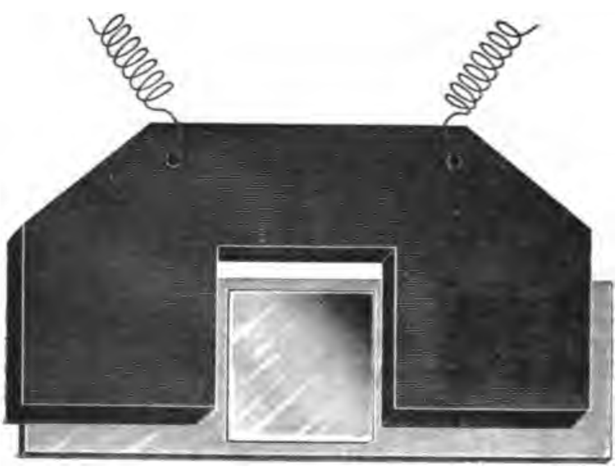

FIG. 48.

"The apparatus consists of a box of ebonite, about the same length as but a little wider than an ordinary slide, and it is three-eighths of an inch thick. There is a gap in the centre 1 in. square, to allow for the cover-slip and objective of the Microscope.

"Pressed into the ebonite box is a coil of wire, which offers a standard resistance to the electric current, and this again is covered in by a sheet of mica—the mica surface being in contact with the slide. Two wires connect the warm-stage with the main electric light circuit. Two brass clips are supplied with each apparatus, so that the warm-stage can be clipped on to the slide if desired.

"That the temperature of the centre of the slide can be maintained at 37° C., it is necessary that there should be a certain amount of resistance on one of the wires connecting the apparatus with the light circuit, which resistance varies according to the voltage. In the first apparatus I made,

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) pp. 12–13.

this took the form of a resistance coil, but it struck me that all the current passing through the coil was wasted, so it was replaced by a lamp, which could light the Microscope and also be the resistance for the warm-stage. For the suggestion that the lamp should be of the Nernst pattern, I am indebted to my brother, Professor Ronald Ross.

"The lamp fills another purpose besides illuminating the Microscope and regulating the amount of current to the warm-stage: it simplifies the question of a change of voltage. Suppose an instrument were procured for a current of 100 volts, and one wished to use it with a current of 230 volts, all that would be necessary would be to change parts of the lamp, and the apparatus is ready for use.

"The lamp is mounted on an oak base, and is supplied with two switches, one for the lamp and one for the warm-stage."

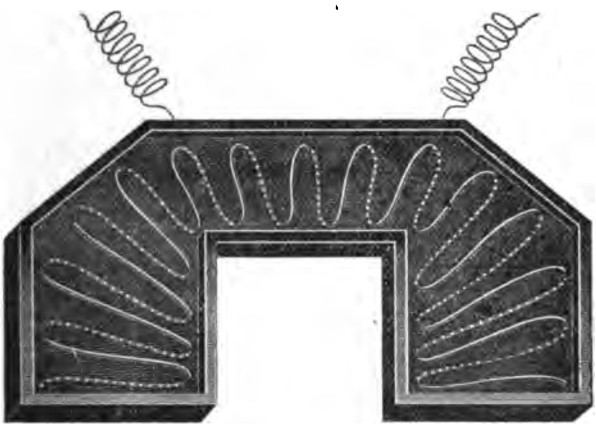

FIG. 49.

Improved Methods of Working with the Vertical Illuminator.* Method I.—With the image of a stop. Method II.—With the stop and the vertical illuminator.

The accessories necessary for Method I. are (1) source of light; (2) carrier for stop; (3) condenser; (4) vertical illuminator. The condenser is first set between the light and the vertical illuminator, so that it forms an aërial image of the source of light at a distance from the vertical illuminator equal to that from the vertical illuminator to the top of the eye-piece. The carrier for the stop is then placed between the light and the condenser in such a position that its aërial image is exactly adjusted and falls sharply in focus at the back lens of the objective. This will give an effect precisely the same as placing a stop or diaphragm over the vertical illuminator itself, while the upward path of the rays from the object to the eye is unimpeded.

The accessories necessary for Method II. are (1) source of light; (2) bull's-eye condenser; (3) vertical illuminator with stop or diaphragm

* Knowledge, ii. (1905) p. 43.

fitted *to its side*. For this method, the lamp and bull's-eye are adjusted as in Method I., care being taken that proper distances are kept, when the same effect will be produced as with a stop or diaphragm placed immediately over the vertical illuminator.

C. Baker's Electric Lamp for the Microscope.—This illuminant consists of a Nernst electric lamp (fig. 50), mounted upon a heavy tripod stand, the feet of which are corked. It is capable of adjustment in a vertical direction, and there is also a tilting movement, to enable the lamp to be used at any angle required.

Fig. 50.

There are three parts to the Nernst lamp, namely, the lamp holder, containing an automatic cut-out; compensating resistance (a small glass bulb containing a fine spiral wire); and the filament itself, mounted on porcelain, and having an electric heater behind it.

These lamps are made for use on two currents, namely, 100 volts and 200 volts, and are provided with either plug or bayonet-joint connections.

The globe covering the luminous filament is blackened, leaving only a small aperture in front, through which the light passes.

Coloured and ground-glass screens, for modifying the light, are carried in front of the globe by means of a removable carrier.

(5) Microscopical Optics and Manipulation.

MILNE, J. R.—**New form of Spectrophotometer.**
[Paper describing the developed form of the instrument, the principle of which was indicated in a previous communication.]
Proc. Roy. Soc. Edinburgh, xxv. (1905) pp. 338–54.

„ „ **New form of Juxtapositor, to bring into accurate contact the edges of the two beams of light used in Spectrophotometry with an application to Polarimetry.**
Tom. cit., pp. 355–63 (3 figs.).

(6) Miscellaneous.

Linnæus and the Use of the Microscope.—Mr. Frank Crisp has kindly forwarded the following letter and extract for insertion in the Journal :—

Perhaps it might be worthy of a note in the Journal to call attention to the fact that Linnæus used a Microscope. I had never heard that he did, but at a Meeting of the Linnæan Society not long since the President, Professor S. H. Vines, F.R.S. D.Sc., mentioned the fact, and I asked him for the authority, which he has sent me as per enclosed manuscript.

Cuff's name has been spun out in the Latin. I should have thought that Cuffianus would have been sufficient. Possibly they thought his name was Cuffin.

Memorandum as to the Use of Microscope by Linnæus.

Amœnitates academicæ, vii., Dissertation cxlvi., Mundus Invisibilis (Roos, 1767), p. 399. Speaking of the Smut of Wheat (*Ustilago*) the author says :—

"Perhibet Auctor, pulvere hoc aquæ immisso et æstivo calore per aliquot dies exposito, vera ovis excludi animalcula. Experimentum hoc iteratum vidimus apud N. D. Præs (i.e. Linnæus) ubi microscopio Cuffiniano hæc (nudo alioquin oculo invisibilia) ad multas vidi myriades."

Translation.—The author asserts that when this powder has been mixed with water, and exposed for some days to summer heat, true animalcules are given off by the ova. We have seen this experiment repeated in the presence of our Mr. President, where, with a Cuffinian Microscope, I have seen them—i.e. the animalcules—(though they are invisible with the naked eye) in many myriads.—S. H. V.

Method of Constructing small Glass Tanks.*—T. G. Kingsford describes the following simple method of constructing glass tanks suitable for aquaria and for light filters.†

The construction is simple and within the range of the amateur mechanic. It consists of 2 glass disks for the sides, a band of thin

* Journ. Quekett Micr. Club, ix. (1904) pp. 117–20 (2 figs.).
† See this Journal, 1904, pp. 383 and 479.

sheet metal (A, figs. 51 and 52) lined with rubber B, and a metal clip or small bolt C, to draw the ends of the band toward each other. In order

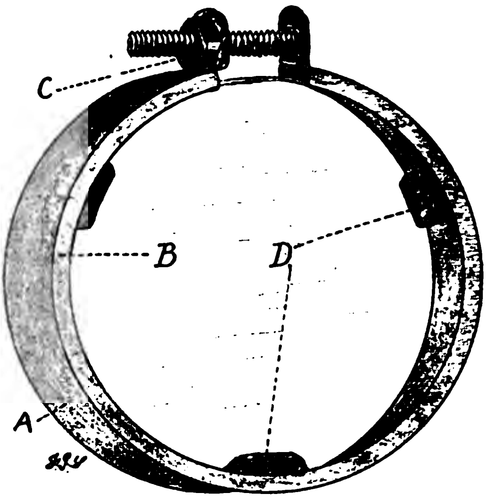

FIG. 51.

to leave an opening for the introduction of fluid the ends of the band do not quite meet. Short strips of rubber, D, are solutioned on to the rubber lining. These serve to keep the glass sides the desired distance

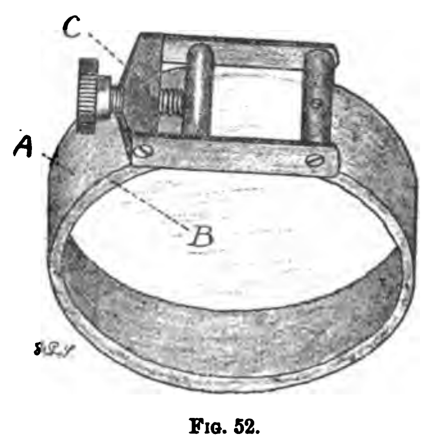

FIG. 52.

apart. Fig. 51 shows a tank ready for use, and intended to be attached to an ordinary bull's-eye condenser stand. The glass sides recommended are bevel-edged clock glasses, obtainable in sizes from

about $\frac{3}{4}$ in. to about 8 in. in diameter. The metal band should not be too stiff.

The form of the tightening clip will depend on the use to which the tank is to be put. If a clear opening be not necessary, the ends of the band are turned up at right-angles, and a small bolt passed through them (fig. 51), but if a clear opening be desired, the form shown in fig. 52 should be used.

Rock Crystal.*—F. J. Cheshire describes the geological conditions of the places where rock crystal, the brazilian pebble of the optician, is obtained, and gives an account of its crystalline nature. In connection therewith, he points out that for high-power spectacle lenses the crystal should be axis-cut, so that the effect of the double refraction of the crystal is minimised as far as possible.

Photogrammetric Focimetry.†—V. Legros treats this subject in a series of articles whose nature may be gathered from his following divisions of the subject:—

Part I. Chap. 1. Principles of the method.
„ 2. Errors of the method.
„ 3. Determination of the nodal points.
„ 4. Curvature of field.
„ 5. Astigmatism.
„ 6. Anomalies of focal length.
„ 7. Definition, focal length, focal volume, luminosity.
„ 8. Chemical focus.
Part II. Chap. 1. Relations of microbiology and of military technology.
„ 2. Improvised microscopic focimetry.
„ 3. Photogrammetric focimeter for microscopical optics.
„ 4. Conclusions.

A New Spherometer.‡—This instrument for measuring the curvature of lenses is described by C. V. Raper. The material for the framework was made of Dr. Guilleaume's "Invar." In figs. 53 and 54 a sectional elevation and plan are given, and it will be seen that the instrument consists essentially of a tripod frame, and a very fine worm and worm-wheel. The frame is built up of the invar rod-stays B and B_1 attached to the top-centre A_1. The two B stays have the conical-pointed feet F affixed at their lower extremities, as plainly shown by the elevation. The B_1 stay, however, lying in the same vertical plane as the horizontal lifting-bar H, is affixed thereto, and the B stays are similarly attached to other horizontal stays H_2 (fig. 55). The horizontal lifting-bars are screwed into the lower centre-piece A_1, both these (top and bottom) centre-pieces being of invar. The invar tube C forming the vertical strut, and also the bearing and nut for the worm-wheel spindle, is a drive-fit into both centre-pieces, and is further secured in the lower centre-piece A by the screwed ends of the two horizontal lifting-

* Revue des Sciences Photographiques (Paris, 1904), Nos. 1–8, about 72 pp., 3 figs.
† Brit. Optical Journ., 1904, pp. 202, 221, 239, 262 (20 figs.).
‡ English Mechanic, lxxx. (1904) pp. 358–60 (4 figs.).

bars H and H_1 penetrating it. The spring pressing on the top of C, the compression of which can be regulated by the knurled brass nut D, is to keep the screwed part of the centre spindle up into the nut,

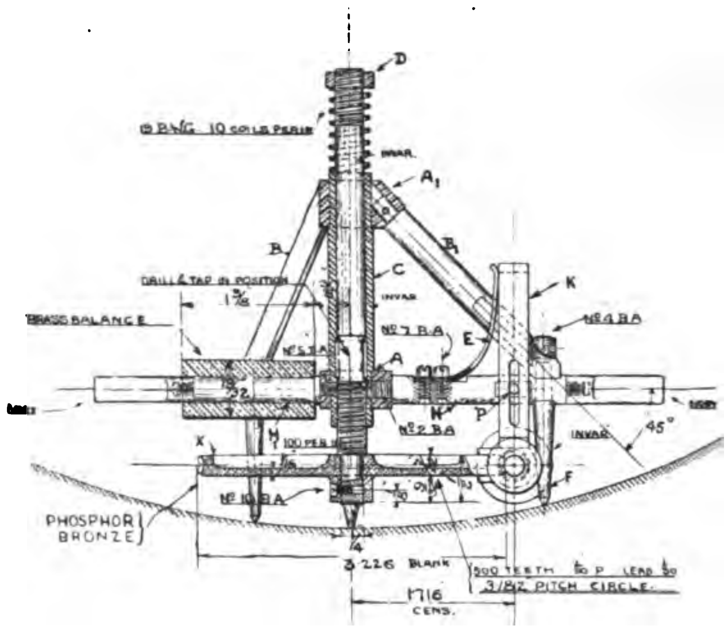

FIG. 53.

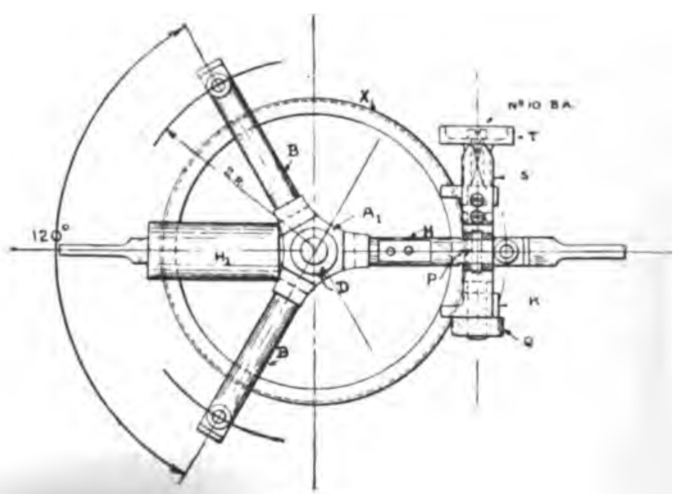

FIG. 54.

thus avoiding any back-lash. The worm-wheel is carried in the invar frame K, pivoting on pin P, which frame is fitted with a slot to accommodate the rise and fall of the worm-wheel, so that worm, wheel and frame can move together. The worm or tangent-wheel W, as shown in the end elevation (fig. 55), is turned solid with its shaft, and is rotated by means of the aluminium thumb-screw T, which is screwed to the worm-wheel shaft, as shown at fig. 55. The invar worm-wheel is kept in gear with the phosphor bronze worm by means of the constant pressure of the tuning-fork-shaped spring E, which spring is screwed to the horizontal lifting-bar H by a couple of screws, as shown by the elevation at fig. 53. The worm-wheel X is driven fast on the centre spindle,

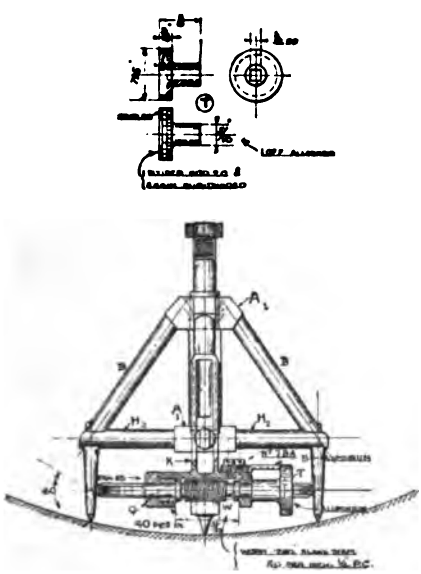

FIG. 55.

and further secured by the No. 10 B.A. screw (fig. 53). The lifting-bar H_1 is fitted with a balance weight, and both lifting-bars have ivory tips. The balance-weight was carefully reduced from an excess until exact balance was obtained, this being highly necessary; balance in the other direction being similarly attained by the bearing Q (fig. 54). The pointed ends of the conical feet F have the sharpness removed sufficiently to prevent them scratching the lens. The vertical spindle is screwed 100 to the inch, the worm-wheel has 500 teeth, one-fiftieth inch pitch, and the worm has 50 threads per inch; thus for one revolution of the worm the vertical spindle, together with the worm-wheel, is raised or lowered one fifty-thousandth of an inch, or one-millionth of an inch for one-twentieth of a revolution of the worm-arbor. It was found that the error of this spherometer was

about one three-millionth of an inch, and as, of course, one five-millionth would make a difference of one-fiftieth of an inch in the focal length of lenses of certain curvature, this error, though mechanically small, is optically considerable. At the same time, the author is doubtful whether a spherometer of greater accuracy could be constructed, and even in that event he thinks the personal and temperature errors would probably nullify the advantage.

F.R.M.S.—Visibility of Minute Flagella.
English Mechanic, lxxx. (1905) p. 527 (4 figs.).

Zeiss, C.—**Stereoscopy: Pulfrich Stereo-Comparators.**
[A catalogue by the Jena firm of this valuable instrument, which is especially applicable to the purposes of Stellar Astronomy, Metronomy, Observations of Sun and Moon, Meteorology, Geology, Topography, Photogrammetry, etc.]
Jena, 1903, 16 pp.

The following reprints of pamphlets by C. Pulfrich bearing on the Stereo-Comparator have been also published by Julius Springer, Berlin; they are extracts from the "Zeitschrift für Instrumentenkunde":—

1. **Ueber einige stereoskopische Versuche.**
August 1901, pp. 221–4 (1 fig.).
2. **Ueber eine Prüfungstafel für stereoskopisches Sehen.**
September 1901, pp. 249–60 (1 fig. and 1 pl.).
3. **Ueber neuere Anwendungen der Stereoskopie und über einen hierfür bestimmten Stereo-Komparator.**
March, 1902, pp. 65–81; May, 1902, pp. 133–41; June 1902, pp. 178–92 (15 figs.).
4. **Neue stereoskopische Methoden und Apparate für die Zwecke der Astronomie, Topographie und Metronomie. Part I.**
[This is practically a collection of all the previous articles.]
J. Springer (Berlin, 1903) 69 pp., 27 figs.
5. **Ueber einen Versuch zur praktischen Erprobung der Stereo-Photogrammetrie für die Zwecke der Topographie.**
November 1903, pp. 317–34 (2 figs.).
6. **Ueber die Anwerdung des Stereo-Komparators für die Zwecke der topographischen Punkbestimmung.** February 1904, 4 pp.

Other reprints, also obtainable through C. Zeiss, on Stereoscopy, are:—

1. C. Pulfrich—**Ueber die bis jetzt mit dem Stereo-Komparator auf astronomischen Gebiete erhaltenen Versuchsergebnisse.**
Reprinted from *V. J. S. der Astron. Gesell. Jahr.* 37, 9 pp., with a stereogram of the moon.
2. Von Hübl, A. F.—**Die Stereophotogrammetrie.**
Reprinted from *Mitt. des K. u. K. Militärgeogr. Inst.*, Band xxii., 16 pp.
3. " " **Die Stereophotogrammetrische Terrainaufnahme.**
Op. cit., Band xxiii, 30 pp., 6 figs., and a stereogram of a mountain landscape.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Tubercle Bacilli from Bacterial Mixtures.†—A. Dworetzky shortly describes Spengler's formalin method for the pure cultivation of tubercle bacilli from bacterial mixtures, and gives details of numerous attempts made by him to obtain pure cultures of the tubercle bacillus from various sources, in every instance without success. After varying the strength of the formalin used, and the time of exposure of the mixtures, he concludes that tubercle bacilli are destroyed with as equal readiness as the other bacteria.

New Levelling Apparatus.‡—This apparatus, devised by S. Serkowski, consists of a thick three- or four-cornered glass or porcelain plate, to which are attached three or four screw feet. After levelling, it may be used for plates or dishes with fluid media; for drying cover-glass preparations, where it is necessary to have thin and even films, also for the observation of fluid preparations, such as urine sediments, the entire microscope being placed on the levelled plate; a microscope, covered by a bell jar, can be more thoroughly protected from dust if kept on this apparatus. If one half is coloured black, and under the other half is pasted a line-ruled white card, like a Wolffhugel's apparatus, it will serve to count the colonies on a plate.

Simplification of the Drigalski Medium.§—In preparing this medium, Hagemann recommends the addition of milk in the place of nutrose and milk-sugar. He obtains the same good results as with the Drigalski-agar, and the preparation is considerably simplified. He stores the milk-agar in quantities of 200 c.cm., and adds alkali, litmus and crystal-violet to the medium immediately before using it. He recommends a 2 p.c. instead of a 3 p.c. agar, since it is more readily filtered.

Differentiation of Streptococci.‖—M. H. Gordon finds that different varieties of streptococci behave in different ways with regard to acid production when grown in litmus broths containing saccharose, lactose, raffinose, inulin, salicin, and mannite; he considers, therefore, that these substances may be of service in differentiating the varieties of these organisms.

Anaerobic Cultures with Phosphorus.¶—A. W. Sellards finds phosphorus a very convenient oxygen-absorbing agent as compared with alkaline pyrogallate. Neither the oxides of phosphorus formed, nor the

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) pp. 628-31.

‡ Tom. cit., pp. 637-40 (1 fig.).

§ Op. cit., 1te Abt. Ref., xxxv. (1905) p. 794.

‖ Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) p. 728.

¶ Tom. cit., pp. 632-7.

vapours of the original phosphorus, affect the nutrient properties or the reaction of the media employed. For hanging drop cultures, special cells were devised to protect the media from the vapours of phosphorus and from its oxides. Test tube cultures were made by substituting a few small pieces of phosphorus for the pyrogallic acid of a Buchner's apparatus. On addition of the potassium hydroxide solution, phosphoric pentoxide is formed, which at once takes up water to form phosphoric acid, which descends as a white cloud; in a few hours the main portion of the oxygen is absorbed, but complete absorption does not result until after 24 hours at the temperature of the incubator.

Spores of *B. tetani*, in 1 p.c. glucose broth, germinated overnight at 37·5° C., and went into spore-formation in 48 hours; stab cultures of this organism grew equally well at the surface and in the depth of the stab; growth was more rapid than by Buchner's method.

Aspergillus niger, a strict aerobe, refused to grow; *Penicillium glaucum* also refused to grow, and still showed no growth on subsequent exposure to air, the spores being destroyed by the absence of oxygen.

B. pyocyaneus and *B. megatherium*, facultative anaerobes, showed no growth within 24 hours; *B. coli communis* and *B. typhosus* at 37·5° C., in glucose broth, showed abundant growth within 24 hours, the colonies of *B. coli* being thin and transparent, those of *B. typhosus* being denser.

Details are given for modifying the method when applied to plate cultures, or for numbers of tube cultures and Smith's fermentation tubes.

In glucose gelatin stabs *B. graveolus*, *B. pyocyaneus*, *B. megatherium*, *B. anthracis*, *Staphylococcus pyogenes aureus*, *Sarcina lutea*, and *Proteus vulgaris* grew feebly, and produced neither liquefaction nor pigment, but on being exposed to the air they regained their vigour and properties of liquefying and producing pigment. The inversion of cane-sugar bouillon inoculated with yeast and also with a mixed culture of inverting forms, was prevented by keeping the cultures in anaerobic conditions. The oxygen was so completely absorbed by the phosphorus that uninoculated media, stained with litmus or methylen-blue, were decolorised within 24 hours.

Cultivation of the Amœbæ of Tropical Dysentery.*—A. Lesage succeeded in cultivating amœbæ from intestinal mucus in the following way: Mucus was taken from, say, 10 places and transferred to as many Petri's capsules. Only capsules which contained living amœbæ were retained, the others being rejected. The living amœbæ were then cultivated in flat glass vials or in test tubes, the medium being agar, which had been washed for 8 days and afterwards sterilised.

The cultivation temperature was from 18° to 25°. The essential feature of the method was to prevent the amœbæ being overgrown by bacteria.

In a few days, small amœbæ could be found. Cultivations were also made on plates on which a paracolon bacillus was growing. In this way living amœbæ could be passed from the human intestine on to a plate without going through the encysted stage.

Another method consisted in cultivating amœbæ from the encysted forms. Some mucus containing living amœbæ was placed in a glass

* Ann. Inst. Pasteur, xviii. (1905) pp. 9-16 (2 pls.).

vessel and a little sterilised water added. The mucus was allowed to dry slowly at from 18–25°. After a few days the dried mucus and water were sown on plates of washed agar. About 1 plate in 10 gave a successful culture. Each of these served as a starting point for obtaining the pure mixed culture by progressively eliminating the bacteria.

Each time the amœba was sown at the bottom of the tube, and the symbiotic bacterium at the top. The plate was kept at 25°. After a few days the amœba reached the upper part, and from here the amœbæ were taken for the next culture.

Cultivating the Bacillus of Leprosy.* — E. R. Rost cultivates *Bacillus lepræ* and also other acid-fast bacilli on media from which chlorine has been removed. The medium is made by distilling beef extract, or by passing a current of superheated steam from the autoclave over boiling beef extract, or by passing superheated steam over the beef extract soaked in pumice stone in bottles inside the autoclave.

By the last procedure a growth of *B. tuberculosis* is obtained in from 1–3 days, of *B. lepræ* in from 3–5 days. The characteristic appearance is a curly white, stringy, heavy deposit at the bottom of the tubes, which is hard to shake up, but, when shaken up, appears as a curly white stringy shred in the tubes.

A satisfactory solid medium is obtained by dialysing nutrient agar in frequently changed warm distilled agar; by this means the sodium chloride is disposed of, and on the surface of the medium the acid-fast group of bacteria grow with greatest ease. The bacillus of leprosy grows at first as a white and later as a yellow, or brick-red, curly thick growth, very much like the bacillus of tubercle on the glycerinised nutrient agar.

The author then calls attention to the staining reactions of *B. lepræ*, and states that it may be differentially diagnosed from other acid-fast bacteria as follows: (1) It retains the stain of acid dyes much more than any of the other bacteria of this class. It retains the stain of carbol-fuchsin even after decolorisation in 25 p.c. nitric acid. (2) It is more irregular than the tubercle bacillus, and not curved, and is somewhat smaller. (3) It contains small oval spores within itself, which are highly refractile, and the end of the bacillus may be open where some have presumably escaped. (4) It has a beady appearance, due to the presence of these oval spores. (5) Like the *B. tuberculosis*, it may grow out into cultures into long, branching filaments, but there are often oval spores separate in the cultures, and these may be alone visible at times. (6) In the body it is found in great numbers inside epithelial cells, generally in the middle of the cells, whereas the *B. tuberculosis* is found in small numbers inside giant cells at the polar ends.

In order to obtain pure cultures from a given case, a tube of the medium is inoculated with a piece of leprous tissue, and incubated at 100° F. In from 3–5 days the thick deposit is examined. It is usually found to contain the bacilli of leprosy and other organisms. The tube is then placed in a warm Petri dish of the dialysed medium. In from 3–5 days colonies of *B. lepræ* may be picked out in the usual way.

Then follows the method of making the toxin, or leprolin.

* Brit. Med. Journ., 1905, i. pp. 294–6.

(2) Preparing Objects.

Preparing Suprarenal Bodies of Guinea-Pigs.* — F. Fuhrmann, who studied the finer structure of the suprarenal bodies of guinea-pigs, found that the best fixatives were Zenker's fluid, Müller's fluid, and formalin in proportion of 9–1; 4 p.c. formalin and saturated sublimate solution in 0·75 p.c. salt solution. For cell examination Hermann's platinum-chloride-osmic-acetic acid mixture, or Flemming's chrom-osmium-acetic acid mixture, gave excellent results, provided the glands were cut up into slices of about 2 mm. thick. After fixation, the pieces were washed in running water, and then hardened in alcohol. Paraffin and celloidin sections were made. For the latter, solutions of celloidin dissolved in methyl-alcohol were used, and the pieces were transferred from ethyl-alcohol to the thinnest, and afterwards passed through the thicker sections. The celloidin was hardened in 65 p.c. alcohol, and was ready for cutting in about an hour. The sections were cleared with origanum oil. One great advantage over the ether-alcohol method is that the fat is much less dissolved out.

The sections were stained by Benda's method—i. e. they were first mordanted with sulphate of iron, and then treated with 1 p.c. aqueous hæmatoxylin solution. They were afterwards differentiated in the freely diluted mordant, or by van Gieson's method. Alizarin I., diluted with 5 parts of water, and with the addition of a few drops of calcium acetate, is also recommended. In this solution the sections remain for 24 hours at incubation temperature. Several other ordinary staining methods gave good results.

BAYON—**Demonstration von Präparaten der normalen und pathologischen Schilddrüse.**

[Contains some remarks on the action of fixatives on the colloid substance of the thyroid gland, and on the nature of the vacuoles.]

SB. Phys.-Med. Gesellsch. Würzburg, 1904, pp. 97–102.

ZILLIACUS, W.—**Die Ausbreitung der verschiedenen Epithelarten im menschlichen Kehlkopfe und eine neue Methode dieselbe festzustellen.**

[Gives method for differentiating the different kinds of epithelial cells in human larynx.] *Anat. Anzeig.*, xxvi. (1905) pp. 25–30.

(3) Cutting, including Imbedding and Microtomes.

Celloidin Method for Hard Plant Tissues.† — A. B. Plowman describes the following celloidin method which was developed and perfected by E. C. Jeffrey. Wood should be cut up into cubic blocks, not more than 1 c.cm., and in such a way that the faces represent the desired plane of section. If dry, the material must be repeatedly boiled to remove the air; the vacuum pump should also be used. Living tissue should be killed and fixed by immersion in the following mixture:— Saturated solution of sublimate in 30 p.c. alcohol, 3 parts; saturated solution of picric acid in 30 p.c. alcohol, 1 part. After 24 hours the fixed blocks are passed through 40, 50, 60, 70, 80 p.c. alcohol, the stay

* Zeitschr. wiss. Zool., lxxviii. (1905) pp. 552–60 (2 pls.).
† Bot. Gazette, xxxvii. (1904) pp. 456–61.

in each being 24 hours, and the 80 p.c. having enough iodine solution to make it a deep brown colour.

The next step is to remove silica or other mineral constituents by immersing the blocks in 10 p.c. hydrofluoric acid for 3 or 4 days, the acid being changed once or twice. This is followed by washing in running water for 2 to 4 hours.

The next step is to dehydrate thoroughly in graded alcohols in the usual way, and remove any residual air with the vacuum pump.

The material is now ready for impregnation with celloidin, which is dissolved in ether and synthol or ether and absolute alcohol. Ten grades from 2 to 20 p.c. celloidin are to be used. The blocks are placed in a bottle, which can be firmly and tightly stoppered, covered with 2 p.c. celloidin solution, and the bottle incubated for 12–18 hours at from 50°–60° C. On removal the bottle is quickly cooled in cold water, after which the 2 p.c. is replaced by the 4 p.c. solution, and so on till the thickest grade is reached. On removal from the last, the celloidinised block is placed in chloroform for 12 hours, and then transferred to a mixture of equal parts of glycerin and 95 p.c. alcohol.

Sections are best made with a sliding microtome; for histological examination a thickness of 10 μ is sufficient, but for photomicrographic purposes they should be as thin as 5 μ or less.

For staining and mounting it is usually advisable to remove the celloidin at this stage by placing the sections for 10 or 15 minutes in ether, and afterwards in 95 p.c. alcohol. The most useful stain is hæmatoxylin, followed by safranin. After staining, the sections are treated in the usual way, and mounted in balsam. It is advisable to clear the sections in the same kind of liquid as is used for dissolving the balsam. For photographic purposes the best stain is Heidenhain's iron-hæmatoxylin. The sections should be repeatedly washed in distilled water after the iron-alum and before they are placed in hæmatoxylin.

In some cases it is necessary to retain the celloidin matrix; the sections should then be dehydrated in a mixture of alcohol and chloroform.

In order to make serial mounts, the sections are cut on the following mixture:—Alcohol 90 p.c., 85 parts; glycerin 15 parts. As the sections are cut, they are arranged on strips of thin smooth paper, and when the alcohol has evaporated the strips are turned face downwards on slides coated with albumen fixative. Several layers of paper are piled on, and the whole pressed down with a squeegee roller covered with another slide. The lot is then clamped together and placed in an incubator to dry for not more than 12 hours. When removed, the paper is stripped off, and the slide with adhering section is treated in the usual way.

Preparing and Staining the Eggs of Haminea Solitaria.* — A. M. Smallwood fixed the eggs with Kleinenberg's picrosulphuric and Conklin's picro-acetic mixtures. In order to facilitate penetration of the fixative, the capsules were torn through with wooden needles. The eggs were left in the fixative for 1 hour, and then transferred to 70 p.c. alcohol, which was changed until the colour due to picric acid was removed.

For staining, Heidenhain's iron-hæmatoxylin was used, followed by

* Bull. Museum Comp. Zool. Harvard. xlv. (1904) pp. 261–318 (13 pls.).

an aqueous solution of Bordeaux red. This procedure was the best, except for fertilisation stages.

In order to differentiate the sperm within the egg from the deutoplasm, the eggs were stained with Delafield's hæmatoxylin, and differentiated with a weak solution of picric acid in 90 p.c. alcohol. This makes the deutoplasm reddish yellow, but leaves the sperm black.

Later experience found that Brazilin was superior to iron-hæmatoxylin. After sectioning, the eggs were mordanted in a solution of iron in 70 p.c. alcohol for 30 to 60 minutes, and then stained for 30 minutes to 2 hours in a ½ p.c. solution of Brazilin in 70 p.c. alcohol. The Brazilin gives a double stain, nucleoplasm staining intensely black, and cytoplasm a Bordeaux red hue. It has the further advantage of being a shorter process, and that it rarely overstains.

Demonstrating Enzyme-secreting Cells.* — H. S. Reed, for his study of the enzyme-secreting cells in the seedlings of *Zea Mays* and *Phœnix dactylifera*, used the following killing fluids:—(1) Saturated solution of picric acid in 50 p.c. alcohol; (2) Aqueous picro-corrosive fluid. This was made by adding 1 vol. of saturated aqueous solution of mercuric bichloride to 3 vols. of saturated aqueous solution of picric acid. After lying 12–18 hours in this fluid, the material was washed in water and dehydrated in alcohol; (3) Kleinenberg's picro-sulphuric acid; (4) Chrom-osmo-acetic acid ;† (5) Iridium chloride in acetic acid (1 p.c. aqueous solution of iridium chloride, 25 c.cm.; glacial acetic acid, 75 c.cm.); (6) Worcester's killing fluid (saturated aqueous solution mercury bi-chloride, 96 parts; formalin, 4 parts; 10 p.c. acetic acid, 10 parts; formic acid, 5 drops to each litre of solution). The tissue was immersed for 10–20 hours, then transferred to 70 p.c. alcohol which contains 1 p.c. potassium iodide; (7) Saturated aqueous solution of mercury bi-chloride in absolute alcohol. The paraffin sections were stained with picro-nigrosin; Kleinenberg's hæmatoxylin; Heidenhain's iron-alum hæmatoxylin; Zimmermann's-fuchsin-iodine green; Gram's method; eosin-toluidin-blue; eosin and anilin-blue; eosin and gentian violet; Flemming's triple stain.

The best staining results were obtained from the eosin-toluidin-blue.

CHAMBERLAIN, C. J.—**Celloidin method for hard tissues.**
[A note in reference to E. C. Jeffrey's method given above.] *Bot. Gazette*, xxxviii. (1904) p. 145.
" " Ditto. *Tom. cit.*, pp. 382–3.
JEFFREY, E. C.— Ditto. *Tom. cit.*, pp. 381–2.

(4) Staining and Injecting.

Staining Protozoa.‡ — F. Marino found that azur in aqueous or alcoholic solution stains well the nucleus and protoplasm of Protozoa fixed in alcohol, and that very dilute aqueous solution of eosin (1:20,000) differentiates them.

A mixture of an aqueous solution of methylen-blue and of azur

* Ann. Bot., xviii. (1904) pp. 269–87 (1 pl.).
† Mottier's formula, Pring. Jahrb., xxx. p. 170.
‡ Ann. Inst. Pasteur, xviii. (1904) pp. 761–5 (1 pl.).

(blue 0·5, azur 0·5, water 100) and an aqueous solution of carbonate of soda 0·5 p.c., is incubated at 37° or more for 24–48 hours. To this is added an aqueous solution of eosin, the strength of which varies with the quality of the blue. The exact quantity must be determined by trying, e.g. 0·1, 0·25, 0·3 p.c. From the filtered mixture is obtained a powder soluble in water and absolute alcohol. The method of staining is as follows:—0·04 grm. of the blue prepared as given above is dissolved in 20 c.cm. methylic alcohol and 0·05 grm. eosin in 1000 of water. On an 18 mm. cover-glass is placed some protozoal blood. To this are added 4 drops of the blue solution. After exactly 3 minutes, and without washing, 8–10 drops of the eosin solution are poured on and allowed to act for 2 minutes.

If the coverslips be larger, a proportionately larger quantity of the staining solutions must be used, and, of course, slides may be used instead of slips.

The preparations are merely washed in water, dried, and mounted in balsam.

While the staining is going on, the preparations must be covered to avoid evaporation and precipitation.

For staining films of microbes fixed in the flame, a 1 : 500 aqueous solution of the blue is allowed to act for half to one minute.

Differential Staining of Bacillus Typhosus in Sections.*—Bonhoff recommends the following method. The section, taken out of absolute alcohol, is washed and fixed on the slide; it is then treated cold for two minutes, with 5 drops of a freshly prepared mixture of saturated alcoholic methylen-blue (4 drops), Ziehl's solution (15 drops) and distilled water (20 c.cm.); it is now warmed over a small gas jet until it commences to steam, washed in water, then in 1 p.c. acetic acid, and again in water; dried with blotting paper, and washed with several lots of anilin and xylol equal parts, and mounted in balsam. The section is stained throughout a light red, the bacilli having an intense sky-blue colour.

CHRISTIAN, H. A.—**Newer aspects of the Pathology of Fat and Fatty Degeneration.** [Mentions use of Osmium tetraoxide, Sudan iii., Scharlach R., and Indophenol for staining fat, and the technique required.]
Johns Hopkins Hosp. Bull., xvi. (1905) pp. 1–6.

Metallography, etc.

Sulphides and Silicates of Manganese in Steel.† — J. E. Stead points out that the identity in shape of the globular masses of these substances may have caused them to be confused with one another. He found that, if the polished surface of a section were examined previously to etching, particles of a pale dove-colour could be tentatively accepted as sulphide. In the case of very minute particles, the reflected actinic light from sulphide of manganese is greater than that from the silicate,

* Centralbl. Bakt., 1te Abt. Ref., xxxv. (1905) p. 794.
† Iron and Steel Mag., ix. (1905) pp. 105–13 (4 figs.).

and a sensitive dry-plate in the camera will show a great contrast between them. Without etching, whilst the object is still under the Microscope, a drop of sulphuric acid (1 of strong acid to 3 of water) should be placed on the surface, and from each sulphide particle a bubble of gas will be evolved, but no gas will form over the pure silicate. This gas can be recognised as H_2S by cementing a small cell or ring of glass on the polished specimen, and placing over this a cover-glass whose underside has been moistened with lead acetate. In a short time a dark stain of lead acetate will form, easily recognisable under the Microscope. The liquid may be removed in a capillary tube and further tested, with nitric acid and bismuthate of soda, for a permanganate reaction. The areas of sulphide and silicate can best be seen after heat-tinting the polished specimens to a light-brown colour, when the patches appear relatively light on a brown ground.

ANDREWS, T.—**Microscopic Observations on Naval Accidents.**
[The author describes his investigations of the cause of failure of the steel connecting-rod of H.M.S. *Bullfinch*.] *Engineering*, Dec. 2, 9, 16, 1904; *Iron and Steel Mag.*, ix. (Jan. 1905) pp. 163–8.

GLEDHILL, J. M.—**Development and Use of High-Speed Tool Steel.**
[A paper read at the Iron and Steel Institute Meeting, New York, Oct. 1904. An historical and descriptive article, describing some of the most recent improvements.] *Iron and Steel Mag.*, ix. (Jan. 1905) pp. 19–44, with figs. and photomicrographs.

SEATON, A. E., & A. JUDE—**Impact Tests on the Wrought Steels of Commerce.**
[The author describes his experiments, and illustrates them by numerous photomicrographs.] *Proc. Inst. Mechanical Engineers*, read Nov. 18, 1904, 33 pp., 10 pls. and 8 figs

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 15th OF FEBRUARY, 1905, AT 20 HANOVER SQUARE, W.
D. H. SCOTT, ESQ., F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 18th of January, 1905, were read and confirmed, and were signed by the President.

Mr. Finlayson's paper describing his Comparascope was read by Dr. Hebb.

The President said he understood that the instrument described in this paper was on the table for inspection. He had seen photographs of it, and also a photograph taken by it, and thought it was clear that there was a use for an instrument of this kind. He had often wanted something of this kind in the course of his work on the structure of fossil plants, as the only means available for comparing objects was by photographs, which did not always show all the detail, so that an invention which enabled two objects to be seen together in the same field of view would be of very great advantage.

Dr. Hebb said that another method of making comparisons between two objects was described in the Society's Journal for February, by which specimens were mounted one over the other on the same slide, so that by focussing up or down either could be brought into focus, and a comparison could be easily made between the normal and abnormal.

Mr. A. D. Michael said that in the case of very small objects, having both in the field at once, without any separate focussing being required, would be a distinct advantage if they were sufficiently in the centre of the field to secure good definition; but where the objects were larger they could not be got into the same field except with a low power, which might not show the details sufficiently. For small objects, however, he thought the arrangement described would answer admirably.

Dr. Hebb said that they had received a photograph of *Pleurosigma angulatum*, taken by Mr. Merlin, and sent to the Society by Mr. Nelson, who thought it one of great excellence.

The photograph was exhibited, and the following description by Mr. Merlin of the method by which it was taken was read by Dr. Hebb: *P. angulatum*. Fractured Valve × 7500. Photographed with Zeiss apochromatic $\frac{1}{8}$-in. N.A. 1·425, and a Powell × 40 compensating ocular. The valve is partly in "pearl dot" and partly in "black dot" focus. Postage stamp fracture and optical intercostals well shown. Axial illumination, with full aperture of Powell's dry apochromatic condenser. The sun's image from a heliostat being sharply focussed on to the valve. No auxiliary condenser employed. Valve mounted in realgar. Deep violet screen. Direct photo taken on an Eastman kodoid film. Exposure, 1 minute.

The thanks of the Society were unanimously voted to the authors of these papers, and to Dr. Hebb for reading them.

Mr. C. Beck exhibited and described an optical bench and large camera, both being on tables and fixing pedestals, in which all the apparatus was fixed upon a strong bar, accurately centred so that the raising and lowering adjustments were obtained by elevating and depressing the bar. A complete apparatus for focal adjustment was provided. The camera and bench had been described in the Journal before, but had not previously been exhibited. He also showed a Metallurgical Microscope with improved focussing arrangement, by which the stage was also raised and lowered; also another model for the same purpose, which allowed of the use of a large number of appliances enabling specimens of considerable size to be examined. A complete set of vertical illuminators, both prism, mirror, and thin glass forms, was also exhibited.

The thanks of the Society were, upon the motion of the President, unanimously voted to Mr. Beck for his exhibits and description.

Mr. J. E. Stead, F.R.S., being called upon to read his paper 'On Practical Micro-Metallography,' said he wished at the outset to express his indebtedness to the authorities of that building for the facilities afforded of exhibiting the machinery before them; to Messrs. Carling and Son, of Middlesbrough, for the loan of the machine and apparatus; to Mr. Plumtree, and to the Union Electric Co. for the use of the motor by which the machinery was worked. In illustration of the subject a series of views were shown upon the screen, the first twenty of which showed the different kinds of apparatus used for the preparation and examination of the specimens. These were followed by a large number of actual specimens depicted upon the screen in the most brilliant manner by means of the Epidiascope—the details of surface, and especially the coloration, being exhibited on a scale and in a manner impossible by any other means; the extremely beautiful colours produced by heating, and especially those upon a polished section of a meteorite, being amongst the finest examples exhibited.

The President said they had listened with the greatest interest to the very remarkable address which had been given that evening, and it was extremely interesting to a biologist to see these examples of microscopic structure, so different from those he was accustomed to meet with.

Mr. Beck said he should like to personally offer his thanks to Mr. Stead for the extremely interesting evening which he had afforded them, and he felt the more satisfaction in doing this as he had himself suggested that Mr. Stead would be the best man to lecture upon this subject. As far as metallography went, he was profoundly ignorant, and certainly, from every point of view, it seemed to be a very difficult branch of science to pursue, but he had some experience as to the difficult subject of illumination with high powers for metallurgy in which his firm had made many experiments. He was much obliged by the suggestion made as to their silver illuminator, which should be carried out. Professor Huntingdon mounted his specimens on a ball, to the back of which was attached a rod which could be fixed at its extremity, so that a slight movement of the mechanical stage gave a very slight alteration in level. Their great difficulty for metallurgical work was to get an object glass which would give a perfectly flat picture for photography, since the usual object of the optician was to get one which

would give as perfect a definition as possible in the centre, and the two conditions were mathematically inconsistent. It might, however, be worth while for the purpose before them to make lenses with a flat photographic field, even at the expense of the definition in the centre. If a lens so constructed should get into the hands of some uninstructed person, the reputation of the maker would be likely to suffer, and this, perhaps, had something to do with the reluctance of opticians to produce them.

Mr. Carpenter said he could only re-echo the very cordial remarks of Mr. Beck.

Mr. Vezey hoped that the absence of remarks on the part of the Fellows present would not be taken as indicating that the very interesting demonstration given by Mr. Stead had not been thoroughly appreciated. He was sure that they had not only been greatly interested, but had been specially pleased at the opportunity afforded of seeing the very beautiful specimens exhibited in a manner which was rendered possible by the fact of the Society having the use of an instrument capable of showing them so perfectly.

Mr. Stead said he would like to mention that he had asked and had responses from all the prominent metallographers in England and abroad, who had sent him a series of lantern photographs with which, had time permitted, he could have continued the subject. He was afraid, however, that if he had started on that, he should have gone on until midnight. He hoped that at some future time he might have an opportunity of showing these to the Society, as he thought they ought to see something of the kind of work which was being done. In every works of any importance microscopic examination of iron and steel was being introduced, and he felt sure that in all such places the Microscope had come to stay.

The President was sure all would be pleased to find that Mr. Stead had held out to them the hope of one day hearing the continuation of this very interesting subject, and of seeing what he had not, for want of time, been able to show them that evening.

A hearty vote of thanks was then accorded to Mr. Stead for his communication.

Mr. Stead said it had given him very great pleasure to bring this subject before them, and he might add that his remarks on Phosphorus in Iron, and the specimens shown, had not been made public before.

New Fellows.—The following were elected *Ordinary* Fellows:— Dr. David Anderson-Berry, John Wm. Bridge, and Rev. Arthur Stanley Hoole.

The following Objects, etc., were exhibited:—

Mr. Conrad Beck:—An Optical Bench and large Camera; a Metallurgical Microscope with improved focussing arrangement; another model, for examining large specimens; Sorby-Beck Reflector; Beck Prism Illuminator, Vertical Illuminator, and Monochromatic Trough.

Mr. D. Finlayson:—The Ashe-Finlayson "Comparascope."

Dr. Hebb:—Photograph of *Pleurosigma angulatum*, taken by Mr. Merlin.

Mr. J. E. Stead:—In illustration of his Demonstration: Machines for cutting and polishing specimens of metals, made by Messrs. Carling

and Son; Lantern Slides of Apparatus used by different investigators in preparing specimens, and of different forms of Microscopes used by Metallographers; a number of actual specimens shown on the screen by means of the Epidiascope.

MEETING

HELD ON THE 15TH OF MARCH, 1905, AT 20 HANOVER SQUARE, W., A. D. MICHAEL, ESQ., F.L.S., ETC., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 15th of February, 1904, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Library, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society voted to the donors.

	From
Dr. J. Bapt. De Toni. Sylloge Algarum. Vol. IV. Florideæ. Section IV. Familiæ I.–VII. (8vo, Patavii, Jan. 9, 1905.)	*The Author.*
W. A. Herdman, D.Sc., F.R.S., P.L.S. Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar. With Supplementary Reports upon the Marine Biology of Ceylon, by other Naturalists. Published at the request of the Colonial Government, by the Royal Society. (London, 4to, 1904)	*The Royal Society.*
Memorandum on the Construction and Verification of a New Copy of the Imperial Standard Yard. Part I.	*The Superintendent of Weights and Measures.*
Monthly Microscopical Journal, 1859–1877, Vols. 1–18 Journal of the Royal Microscopical Society, 1878–1882, 5 vols. in 9 vols.	*Mr. R. L. Howard.*

Mr. J. E. Stead, F.R.S., then delivered the second part of his lecture on Micro-Metallurgy. Referring to the lecture delivered at the previous Meeting, he reminded the Fellows present that he had on that occasion described the methods by which metals were prepared and polished for microscopical examination, and had exhibited a number of specimens upon the screen, but he had then, for want of time, been unable to show a large number of lantern slides which had been sent to him by nearly all of the most eminent metallographers for the purpose of his lecture, many of which would be exhibited for the first time this evening. Those to whom he felt specially indebted were:—Dr. Sorby, M. Osmond, Professor Arnold, Professor H. le Chatelier, Dr. T. K. Rose, Professor J. A. Ewing, Mr. Rosenhain, Mr. G. T. Beilby, Messrs. Heycock and Neville, Mr. W. H. Merrett, Mr. F. W. Harbord, and Professor Heyn, of Charlottenburg.

Micrograms reproduced from the illustrations in Dr. Sorby's original papers clearly showed that, as far as his work went, it was of a good and accurate character, and that subsequent observations by more modern workers had confirmed all he had done.

In referring to the work of Osmond upon steel, it was shown by his illustrations, and also by the work of the lecturer and other observers, that whilst the hardenite in steels quenched from a point a little above the recalescence point $Ar_{1\text{-}2\text{-}3}$, although crystalline, was practically amor-

phous, on heating to and quenching from a higher temperature, a crystalline structure was strongly developed, and had the same characteristics as martensite in steels containing less carbon.

Troostite and austenite, although not thoroughly understood, had been recognised as true micro-constituents.

Sorbite, like troostite, required more study. It was neither troostite nor pearlite, and Osmond had described it tentatively as unsegregated pearlite. As much discussion had taken place during the last few years with regard to the nature of the micro-constituents—sorbite, troostite, and austenite—a committee had been formed to work under Dr. Glazebrook, of the National Physical Laboratory, to endeavour to ascertain their true nature.

The work of Professor Arnold was illustrated by slides made from accurate drawings of the structures of cement steels and steels containing sulphur.

The lecturer expressed great appreciation for Arnold's drawings, and pointed out that in many cases they were preferable to photographs, but that generally photographs were better when properly taken.

The special features of Professor H. Le Chatelier's work were illustrated by photomicrographs of cast irons and steels, some of the structures of which had been developed by the action of potash and lead oxide, which darkened the cementite but left the other constituents white.

The mid-ribs of cementite in the dark barbs of martensite were in this way clearly shown.

The effect of strain and continued reversals of stress on iron was illustrated by photomicrographs prepared by Professor J. A. Ewing, Mr. Walter Rosenhain, and Mr. Humphrey.

The surface-flow of metals was illustrated by the elaborate work of Mr. G. T. Beilby.

The work of Mr. W. H. Merrett, of the Royal College of Science, was represented by photographs of granular pearlite, magnified 1600 diameters, which showed that the carbide of iron, or cementite, existed in globular or roughly-shaped globular particles completely separated from each other.

The micro-structures of steels produced by electrical processes were given by slides provided by Mr. F. W. Harbord, and shown to be identical with the micro-structures of steels made by the ordinary processes.

The structure of bronzes was very beautifully illustrated with slides provided by Messrs. C. T. Heycock and F. H. Neville, Cambridge. The lecturer, in describing the work of those gentlemen, remarked that the research upon Copper and Tin Alloys, presented to the Royal Society, was of the highest merit, and a type of work such as students, who wished to study metallic alloys, should take as an example.

At the conclusion of the lecturer's remarks—there being no time for discussion—the Chairman said he felt sure that all who were present would join in a very hearty vote of thanks to Mr. Stead for the exhibition given to them that evening of a very remarkable and highly interesting series of slides illustrating a subject of great scientific and economic interest.

The thanks of the Meeting were then unanimously voted to Mr. Stead for his very interesting communication.

Mr. Stead, in responding, said he thought he himself ought to thank

the Society not only for the opportunity afforded him of showing what was to him a series of illustrations of remarkable interest, but also to the Fellows present that evening for the patient manner in which they had listened to what, he feared, had taken more time than he had anticipated.

In further illustration of the subject a large number of specimens were exhibited in the room at the close of the Meeting.

The following Instruments, Objects, etc., were exhibited:—

Mr. J. E. Stead:—Lantern slides and the following specimens in illustration of his lecture.

A. Soft plates of pure iron, soldered together by phosphide of iron, and forged from 1 in. to $\frac{1}{8}$ in. in thickness. One portion was annealed at 1350°, the other was not annealed. Both were polished and heated at one end in a lead bath, so as to produce heat-oxidation tints. The unannealed specimen showed blue phosphide lines on a brown ground. The tints on the annealed portion were uniform, showing that the phosphide *had completely diffused.*

B. Alternate plates of wrought iron, containing 0·01 p.c. and 0·25 p.c. phosphorus welded together, sectioned and polished, and etched with picric acid solution, which coloured the phosphorised iron brown, but left the pure iron white.

C. Wrought iron of commerce, polished, heat-tinted, and slightly etched with very dilute nitric acid. The section showed a series of differently coloured bands, the colour varying with the amount of phosphorus in the iron.

D. Puddled bar, polished and etched with picric acid, which coloured the more highly phosphorised parts brown.

E. Segregationed steel bar, etched with picric acid, showing a brown patch in the centre, high in phosphorus.

F. Steel bar containing 1·3 p.c. carbon, which had been heated at one end to whiteness, and after cooling to 800° C. it was quenched in water. The constituents—martensite, troostite, sorbite, and pearlite—were all visible in the picric-acid etched metal.

G. Compound steel safe plate, composed of alternate layers of steel, with 0·05 p.c. carbon, and steel with 0·9 p.c. carbon, etched with picric acid. The hard steel was coloured brown, the soft steel remained white.

H. Loluca meteorite, polished and heat-tinted. The Widmanstatten structure was very perfectly developed.

I. A steel forging, containing what is known as a phantom or ghost, or an area lenticular in section, high in sulphur and phosphorus. The phantom had a blue tint on a ground-mass coloured brown. The colours were developed by heat-tinting.

J. Messrs. J. Swift and Son: Mr. Stead's External Cover-glass Reflector for low-power objectives for illuminating opaque objects.

New Fellows: — The following were elected *Ordinary* Fellows: Messrs. George Albert Evans, John Mastin, and Eliezer Moffat. The following were elected *Honorary* Fellows: Professor William Gilson Farlow, Professor Herbert S. Jennings, Professor Edmund B. Wilson, and Professor R. W. Wood.

COUNCIL
OF
THE ROYAL MICROSCOPICAL SOCIETY.
ELECTED 18th JANUARY, 1905.

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Dukinfield Henry Scott, M.A. Ph.D. F.R.S. F.L.S.

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The Right Hon. Sir Ford North, P.C. F.R.S.
Henry George Plimmer, F.L.S.
Henry Woodward, LL.D. F.R.S. F.G.S. F.Z.S.

TREASURER.—J. J. Vezey.

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R. G. Hebb, M.A. M.D. F.R.C.P.

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Assistant Secretary.—F. A. Parsons.

ROYAL MICROSCOPICAL SOCIETY.

MEETINGS FOR THE SESSION 1904—1905

AT 8 P.M.

Wednesday, Oct. 19, 1904
" Nov. 16, "
" Dec. 21, "
" Jan. 18, 1905
(Annual Meeting for Election of Council and Officers.)
Wednesday, Feb. 15, 1905
" Mar. 15, "
" Apr. 19, "
" May 17, "
" June 21, "

Fellows intending to exhibit any Instruments or Objects, or to bring forward any Communications at the Ordinary Meetings, will much facilitate the arrangement of the business thereat if they will inform the Secretaries of their intention two clear days at least before the Meeting.

Computed by Mr. E. M. Nelson from the New Coefficient obtained by Order of the Board of Trade in 1896.

LINEAL.

Metric into British.

μ	in.
1	·000039
2	·000079
3	·000118
4	·000157
5	·000197
6	·000236
7	·000276
8	·000315
9	·000354
10	·000394
11	·000433
12	·000472
13	·000512
14	·000551
15	·000591
16	·000630
17	·000669
18	·000709
19	·000748
20	·000787
21	·000827
22	·000866
23	·000906
24	·000945
25	·000984
26	·001024
27	·001063
28	·001102
29	·001142
30	·001181
31	·001220
32	·001260
33	·001299
34	·001339
35	·001378
36	·001417
37	·001457
38	·001496
39	·001535
40	·001575
41	·001614
42	·001654
43	·001693
44	·001732
45	·001772
46	·001811
47	·001850
48	·001890
49	·001929
50	·001969
60	·002362
70	·002756
80	·003150
90	·003543
100	·003937
200	·007874
300	·011811
400	·015748
500	·019685
600	·023622
700	·027559
800	·031496
900	·035433
1000 (=1 mm.)	

mm.	in.	mm.	in.
1	·039370	56	2·204726
2	·078740	57	2·244096
3	·118110	58	2·283467
4	·157480	59	2·322837
5	·196851	60	2·362207
6	·236221	61	2·401577
7	·275591	62	2·440947
8	·314961	63	2·480317
9	·354331	64	2·519687
10	·393701	65	2·559057
11	·433071	66	2·598427
12	·472441	67	2·637798
13	·511811	68	2·677168
14	·551182	69	2·716538
15	·590552	70	2·755908
16	·629922	71	2·795278
17	·669292	72	2·834648
18	·708662	73	2·874018
19	·748032	74	2·913388
20	·787402	75	2·952758
21	·826772	76	2·992129
22	·866142	77	3·031499
23	·905513	78	3·070869
24	·944883	79	3·110239
25	·984253	80	3·149609
26	1·023623	81	3·188979
27	1·062993	82	3·228349
28	1·102363	83	3·267719
29	1·141733	84	3·307089
30	1·181103	85	3·346460
31	1·220473	86	3·385830
32	1·259844	87	3·425200
33	1·299214	88	3·464570
34	1·338584	89	3·503940
35	1·377954	90	3·543310
36	1·417324	91	3·582680
37	1·456694	92	3·622050
38	1·496064	93	3·661420
39	1·535434	94	3·700791
40	1·574805	95	3·740161
41	1·614175	96	3·779531
42	1·653545	97	3·818901
43	1·692915	98	3·858271
44	1·732285	99	3·897641
45	1·771655		
46	1·811025		
47	1·850395		
48	1·889765		
49	1·929136		
50	1·968506		
51	2·007876		
52	2·047246		
53	2·086616		
54	2·125986		
55	2·165356		

dm.	in.
1	3·9370113
2	7·8740226
3	11·8110339
4	15·7480452
5	19·6850565
6	23·6220678
7	27·5590791
8	31·4960904
9	35·4331017

1 metre = 3·2808428 ft.
= 1·09361426 yd.

British into Metric.

in.	mm.
1	25·399978
2	50·799956
3	76·199934
4	101·599912
5	126·999890
6	152·399868
7	177·799846
8	203·199824
9	228·599802
10	253·999780
11	279·399758
1 ft.	304·799736
1 yd.	914·399208

in.	mm.
$\frac{1}{2}$	12·699989
$\frac{1}{3}$	8·466659
$\frac{2}{3}$	16·933319
$\frac{1}{4}$	6·349994
$\frac{3}{4}$	19·049983
$\frac{1}{5}$	5·079996
$\frac{2}{5}$	10·159991
$\frac{3}{5}$	15·239987
$\frac{4}{5}$	20·319982
$\frac{1}{6}$	4·233330
$\frac{5}{6}$	21·166648
$\frac{1}{7}$	3·628568
$\frac{1}{8}$	3·174997
$\frac{3}{8}$	9·524992
$\frac{5}{8}$	15·874986
$\frac{7}{8}$	22·221980
$\frac{1}{9}$	2·822220
$\frac{1}{10}$	2·539998
$\frac{3}{10}$	7·619993
$\frac{7}{10}$	17·779985
$\frac{9}{10}$	22·859980
$\frac{1}{11}$	2·309089
$\frac{1}{12}$	2·116665
$\frac{5}{12}$	10·583324
$\frac{7}{12}$	14·816654
$\frac{11}{12}$	23·283313
$\frac{1}{13}$	1·953844
$\frac{1}{14}$	1·814284
$\frac{1}{15}$	1·693332
$\frac{1}{16}$	1·587499
$\frac{3}{16}$	4·762496
$\frac{5}{16}$	7·937493
$\frac{7}{16}$	11·112490
$\frac{9}{16}$	14·287487
$\frac{11}{16}$	17·462485
$\frac{13}{16}$	20·637482
$\frac{15}{16}$	23·812479
$\frac{1}{17}$	1·494116
$\frac{1}{18}$	1·411110
$\frac{1}{19}$	1·336841

in.	mm.
$\frac{1}{20}$	1·269
$\frac{1}{21}$	1·209
$\frac{1}{22}$	1·154
$\frac{1}{23}$	1·104
$\frac{1}{24}$	1·058
$\frac{1}{25}$	1·015
$\frac{1}{30}$	·846
$\frac{1}{35}$	·725
$\frac{1}{40}$	·634
$\frac{1}{45}$	·564
$\frac{1}{50}$	·508
$\frac{1}{55}$	·4618
$\frac{1}{60}$	·423
$\frac{1}{65}$	·3907
$\frac{1}{70}$	·3628
$\frac{1}{75}$	·338
$\frac{1}{80}$	·3175
$\frac{1}{85}$	·298
$\frac{1}{90}$	·282
$\frac{1}{95}$	·267
$\frac{1}{100}$	·2540
$\frac{1}{150}$	·169
$\frac{1}{200}$	·1270
$\frac{1}{250}$	·1016
$\frac{1}{300}$	·084
$\frac{1}{350}$	·072
$\frac{1}{400}$	·063
$\frac{1}{450}$	·0564
$\frac{1}{500}$	·0508
$\frac{1}{550}$	·0461
$\frac{1}{600}$	·0423
$\frac{1}{650}$	·0390
$\frac{1}{700}$	·0362
$\frac{1}{750}$	·0338
$\frac{1}{800}$	·0317
$\frac{1}{850}$	·0298
$\frac{1}{900}$	·0282
$\frac{1}{950}$	·02673

in.	μ
$\frac{1}{1000}$	25·39997
$\frac{1}{2000}$	12·69998
$\frac{1}{3000}$	8·46665
$\frac{1}{4000}$	6·3499
$\frac{1}{5000}$	5·07999
$\frac{1}{6000}$	4·23333
$\frac{1}{7000}$	3·62856
$\frac{1}{8000}$	3·17499
$\frac{1}{9000}$	2·82222
$\frac{1}{10000}$	2·53999
$\frac{1}{15000}$	1·69333
$\frac{1}{20000}$	1·26999
$\frac{1}{25000}$	1·01599

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TRANSACTIONS OF THE SOCIETY.

III—*Micro-Metallography with Practical Demonstration.*

By J. E. Stead, F.R.S.

(*Read February 15th*, 1905.)

As metals are opaque, it is impossible to deal with them as the mineralogist deals with his rocks and minerals. Therefore, the metallographer is obliged to depend upon what is revealed upon their polished surfaces. On this account it is not necessary to have specimens of any particular shape, size or thickness. The only thing absolutely essential is that one surface is perfectly flat, and is polished so as to have a mirror-like appearance, free from scratches.

It was Dr. Sorby, of Sheffield, who first elaborated a system for the examination of the micro-constituents of Iron and Steel. His methods are so well known that it is scarcely necessary to give them here in detail. It is sufficient to state that the metals were polished by hand on a series of emery papers diminishing in coarseness, and finished upon rouged parchment.

Polishing by hand takes a long time, and although the work when properly finished is perfect, it has been found a very great convenience to expedite the process by means of quick running discs and grinding appliances worked by electrical or other power.

Professor Martens polished on beds of pitch containing grinding powders mechanically suspended, which were placed on the head of a wheel running horizontally. A series of many specimens were fixed with cement to a holder, which was caused to traverse backward and forward across the polishing surface.

Osmond proceeds by first grinding on emery papers by hand, roughly polishing on rouged cloth, and then on a wheel covered

with rouged parchment for fine polishing. He has given, in his book upon the microstructure of metals, detailed instructions for the polishing of metals and the preparation of the emery papers which he found most suitable.

Professor Arnold prepares his specimens on revolving horizontal polishing blocks, and Mr. Sauveur on vertical running wheels, the polishing being effected on the sides of the discs. Professor H. Le Chatelier, on the other hand, polishes on the periphery of vertical wheels.

Each authority quoted has done excellent work, and it may be accepted that all the devices have given satisfaction in the hands of the operators.

Professor H. Le Chatelier prepares alumina powder for the polishing, and a description of the method has already been furnished to this Society by Mr. W. H. Merrett.

Messrs. Carling and Son, machinists, Middlesbrough, have for many years been devoting much attention to the construction of suitable devices for polishing metals by machinery, examples of which are exhibited here to-night by their consent. The principle of working is the same as that of other machines, such as are used by Professor Ewing, Mr. W. Rosenhain, Mr. W. H. Merrett and others, but there are certain improvements which are possible advantages, and which have enabled me to perfectly polish a specimen of steel one centimetre square in about five minutes after it is cut by the saw, or filed smooth.

An examination of the accompanying photograph (fig. 56) will show at a glance the construction of the machine.

The shaft of the revolving wheel rests upon a polished steel ball to prevent friction, and is caused to revolve by the cord connected to a power-driven pulley, preferably a $\frac{1}{8}$-horse power electric motor, running at such a speed that the little wheel revolves at the rate of between 500 and 1000 revolutions per minute. The sheath S prevents the projection of the water, which is caught and conveyed to the trough T. The sheath has the additional advantage that it affords a rest for the hand when holding the specimen, and enables the operator to regulate the pressure.

A series of loose conical blocks B are placed simply alternately as required on the top of the wheel A, the friction of which is sufficient to carry them round without slipping.

The block, No. 1, is prepared by stretching a piece of the finest emery cloth over its surface and securing it in position by pressing the ring over the cloth and cone. The surplus cloth is removed with a knife.*

The other blocks are prepared in precisely the same way, but instead of emery cloth the paper manufactured in France for

* These conical blocks are similar to the hand-polishing blocks designed by Professor Arnold.

polishing engraving plates is substituted. The second block is covered with paper marked "Hubert 0," the third block with

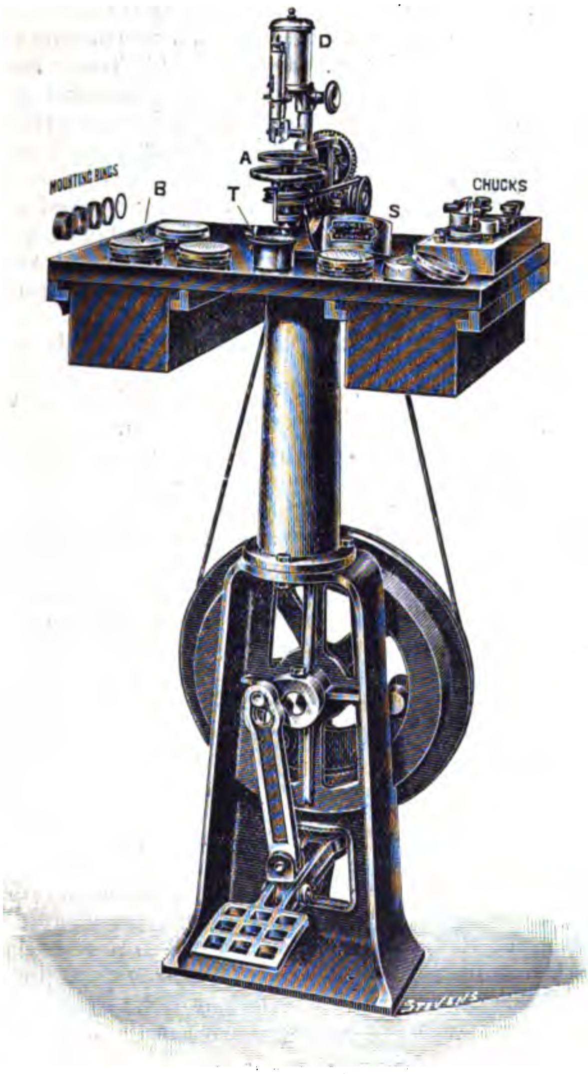

FIG. 56.

paper marked "Hubert 000." The fourth block is covered with a ribless cloth of considerable thickness, denseness and texture.

Special care is necessary in the preparation of this block, for upon it the polishing is finished. On the top of the block is placed a small disc of cloth of exactly the same diameter as the upper area of the block. Upon this is sprinkled pretty thickly a covering of about one gramme of diamantine powder, a preparation of calcined alumina manufactured by A. Guyot Dupold, Tocle, Switzerland, which is quite as satisfactory as the calcined alumina prepared as directed by Professor H. Le Chatelier, and it has the advantage that it can be readily obtained from any jeweller at a small price. This diamantine powder, having been placed upon the cloth disc, a larger piece of cloth is placed over it and the ring pressed home over the cone. Arranged in this way, any of the larger particles of powder are prevented from passing upwards through the pores of the cloth, and only the finest portions reach the upper surface and are utilised in the polishing.

Professor Arnold has independently found this method of procedure to be very useful.

Many metallographers prefer to use large blocks or wheels for polishing, but in my experience it has been found that with smaller ones there is less danger of dust getting on the cloth, and the apparatus is more convenient and less cumbersome.

In the many designs for polishing apparatus, shown at this meeting, it will be observed that some are fitted with a series of blocks in which all the necessary grinding and polishing surfaces are close together, and there is no necessity of changing the blocks. On the other hand there is a machine with larger blocks to suit those who prefer them, and there is also a single table with interchangeable discs. All these machines can be fitted with the traversing specimen holders, so that polishing becomes practically automatic. I am under great obligation to the makers for allowing these to be exhibited this evening.

Selection of Specimens.

When a metallographer is called upon to make an examination of a metal structure, which has broken or failed when in use, it is most important that all particulars should be provided him, with exact details as to the nature of the strains and stresses applied, where they were applied, and whether, or not, any local distortion of the metal substance has been produced in the machine shop, or when in practical use.

In selecting the position from which specimens shall be taken, the metallographer must be largely guided by the information he receives. All fractures or failures in metals have initial starting points, and it not infrequently happens that the seat of weakness is located exactly at this point, and possibly nowhere else. A

piece of machinery, for instance, may have perfect mechanical properties, a perfect microstructure, be of correct mechanical design, and yet fail when in use, because of some slight depression or flaw in the surface of the metal. When these are present, it is of very little use to make further investigation, because these irregularities are almost always sufficient to account for the failure. If they are absent, it is important that the metal near to the initial point of fracture should be selected for microscopic examination, for it is quite possible that this particular part may have been weakened by some kind of incorrect thermal or mechanical treatment, when possibly no other part of it may have been so affected.

It often happens that engineers and others, who wish to have a micro-examination of the metal, cut off a piece perhaps several inches away from where the fracture initiated, and expect the metallographer to diagnose from the structure the cause of fracture.

It is important also in metals which have been rolled or forged that longitudinal as well as cross sections should be examined, for it not infrequently happens that what cannot be seen in the cross section becomes quite evident in the specimen cut longitudinally.

In selecting specimens from worn surfaces, such as rails, tyres, and other similar metals, two such surfaces should be placed face to face, so that the worn parts of the metal constitute a line between the two sections. After placing face to face the two pieces, 1 cm. by ½ cm. by ½ cm., they are held in position in a vice, and a little solder placed on the back of them in sufficient quantity to keep then in position. Care should be taken to place the lower part, opposite to the soldered end, against a metal plate, so that the surface to be examined does not become heated. The specimen is then ground and polished in the usual way, and a section of the worn or crushed surface can be examined. If this precaution of placing the pieces together is not taken, and an attempt is made to polish the metal in the usual way, the worn surface will become rounded on the polishing blocks, and it will be difficult to study it properly.

In the preparation of samples of wire, first of all it is necessary to obtain pieces of steel about the same hardness as the wire, 1 cm. square and ½ cm. in thickness. In the centre of this a hole is drilled of exactly the same thickness as the wire. The latter is inserted in the hole, the metal placed on a steel block, and the back of the specimen secured in position by solder. The section is then polished in the usual way. Longitudinal sections are prepared by soldering several pieces of wire on a small block 2 cm. by ½ cm. by 1 cm., but only at the extreme ends, so as to avoid heating the central parts, which alone are examined. All the pieces are then ground down to half their diameter, and the surfaces are polished and etched in the usual way.

On examining sections of material such as tin plate sheets, similar supports of metal must again be provided. Fine cuts with a fret saw are made in the centre, half way through the support, and pieces of tin plate are slipped into the slits. They are retained there by squeezing the metal in such a way as to cause the two sides of it to press against the enclosed pieces of sheet.

Polishing the Specimens.

In general practice, it has been found that the polishing is more rapidly effected by holding the specimen in the hand than by fixing it in the automatic holders. One's finger tips suffer somewhat when many samples are polished, but that is not a serious objection.

Block No. 1 is placed on the wheel, and by means of a switch the current of electricity is turned on to the motor. As the horizontal wheel revolves, the specimen, sawn or filed to shape, is pressed on to the surface of the block with considerable force at first, and then with gradually diminishing pressure until the saw or file marks are removed. This operation does not take more than a minute. The current is switched off, No. 1 block is replaced by No. 2, and the specimen passed over this. After changing No. 2 for No. 3, the specimen is rough polished thereon. No. 4 block (cloth cover) is now put on the wheel, water is run on to the surface, and the final polishing completed.

One great secret of success in polishing is to gradually diminish the pressure of the specimen on the blocks, commencing with heavy pressure and finishing with practically none, and to pass the specimen round the block in an opposite direction to that in which the wheel is rotating.

The block with the "000" emery covering requires some little preparation before it is suitable for fine grinding. This is effected by covering it with rouge, and pressing a flat piece of polished steel upon its surface when rapidly revolving. After rotating for about five minutes, the surface of the block is rubbed with a piece of fine linen cloth to remove all the gritty particles. This operation is twice repeated, after which the surface will be in a most suitable condition for practical work, and if care is taken will be capable of polishing from fifty to sixty specimens.

The cloth block, in spite of all precautions, may occasionally become contaminated by dust and grit. This is very soon discovered by the appearance of curved lines upon the specimen which is being polished. In such case the block is removed and placed in running water, and the cloth is meanwhile rubbed with the finger. In this way the grit will become dislodged.

When polishing upon this block it is important that it should

be kept moist by allowing water to fall upon its surface from the reservoir D. In the bottom of this reservoir there is placed a plug of cotton-wool to prevent the passage of any grit.

When polishing copper, brass, and softer metals the No. 4 block is lubricated with oil instead of water.

It will be noticed that in the description just given there is nothing required excepting what can be obtained commercially.

The emery paper can be obtained from any ironmonger, the cloth from any tailor, and the diamantine powder from any jeweller.

Mounting the Specimens for Microscopic Examination.

There have been several devices described for the purpose of mounting specimens upon glass slides for microscopical examination. Mr. Merrett uses a mixture of wax, but for my own part I find that there is nothing better than the plasticine used by children for model making, a material which constantly remains plastic both in summer and winter, and has, moreover, the good property of adhesiveness. This can be obtained from any kindergarten stores, at very little cost, or from dealers in polishing apparatus.

A most accurate and certain method of obtaining the polished surface of the metal in true parallel plane with the plane of the Microscope slide is to place the polished surface of the specimen upon a piece of plate-glass, and to place over this a short cylinder of brass or other metal, the two ends of which are parallel, and whose height is sufficient to extend a little beyond the back of the specimen. A piece of plasticine having been stuck on to the glass slide, this is pressed upon the specimen until the glass rests on the upper end of the cylinder. The slide is then removed, together with the specimen adhering to it.

Messrs. Watson and Sons have one or two devices for levelling metal sections on the stage of the Microscope, one of which has been designed by Mr. Rosenhain; and Messrs. Swift and Sons have prepared, to my design, a device which is most satisfactory.

Messrs. Heycock and Neville have a very neat way of marking their glass slides. Instead of plain slips they use ground glass, and write in pencil upon the frosted surface a description of the nature and character of the object. The necessity of having some simple method of marking will be obvious when it is known that it is often necessary to immerse the metal sections after mounting in etching fluids. Gummed labels would come off and be lost under such treatment. In practice it has been found more convenient to use glass slips 2 in. by 1 in. instead of those 3 in. by 1 in.

Methods of Etching.

The chief advance made in metallography of recent date consists in the method of developing the structures of metals.

Dr. Sorby and Professor Arnold recommend the use of nitric acid in different degrees of concentration, but, excepting in such cases when vigorous action is required and for very pure steels free from phosphorus and sulphur, nitric acid does not give good results.

M. Osmond devised a process of showing up the pearlitic and other structures of steels, which he described as the "polissage attack," which consisted of rubbing the polished metal section on parchment, moistened with a solution of liquorice-root in water, or a 2 p.c. solution of nitrate of ammonia in water. When the proper pressure is applied, after a little practice, it is possible to get a very perfect development of the structures of steels by this method.

Tincture of iodine has been used by Osmond and others with very satisfactory results, and for a long time I have found this a most admirable reagent for differentiating between the appearance of such portions in steels, which are relatively higher in phosphorus, from those containing less of that element. Iron or steel containing much phosphorus is less readily corroded or attacked by iodine than similar material containing little of that element. By taking advantage of this peculiarity, when a given piece of metal contains more phosphorus in one part than in another, it is easy by the action of dilute iodine to find out where the high phosphorus portions are located.

M. Ischewsky, in the laboratory of Professor H. Le Chatelier, discovered that a 5 p.c. solution of picric acid in absolute alcohol would give the same constant and perfect development of the structure of pearlite in steel as was obtained by the "polish attack" of Osmond, and this reagent is almost universally recognised as one of the most valuable reagents for etching steels.

On applying picric acid in the development of steels containing high percentages of phosphorus, it has been found that by long continued action it causes the portions highest in phosphorus to become brown relatively more rapidly than the other parts.

Brasses, containing varying proportions of copper, when placed side by side in the picric solution, become coloured in different degrees and at varying periods.

It is possible that the same reagent may be used for other alloys with advantage.

Professor H. Le Chatelier has discovered that alkaline oxidising reagents have the peculiarity of darkening carbide of iron when in

the massive state in steel, and considering that no other reagents yet employed have succeeded in causing it to become tinted, these must be regarded as valuable additions to our etching fluids.

Professor Heyn has used a 10 p.c. solution of double chloride of copper and ammonium for the purpose of developing the crystalline structure of iron, a reagent which has been proved to be of great value and service, and is recognised as a standard reagent by many workers.

Messrs. Heycock and Neville have found that in the study of the bronzes, ferric chloride in alcohol is a most valuable reagent for the development of the structures of such alloys.

M. G. Charpy and others have used the electrical method of etching with advantage, in which the specimen is attached to one of the poles of a battery and immersed in a suitable etching liquid, such as hydrochloric acid, the metal being electrically dissolved from the surface. This method has given very good results in the development of the structure of brasses, and of austenite and martensite in high carbon steels.

Other reagents, such as the tinctures of hydrochloric acid, nitric acid, and bromine, have been used with success.

One of the most beautiful methods of revealing the structure of metals consists in heating the brightly polished specimens until they assume oxidation-coloured films. Professors Behrens and Martens and others have been most successful in the application of this method. Professor Cohen has also used it in differentiating the various constituents in meteorites.

Microscopes for Metallography.

Microscopes suitable for metallography are supplied by most of the good makers, and there is no difficulty in obtaining what is required in that direction, but in metallographic work the Microscope does not require any substage, and the stage itself should be arranged in such a way as to be capable of being racked downwards so as to admit of giving a large space between the object-glass and the object itself. Indeed, an ideal Microscope is one in which a gap of 8 in. can be made. The reason for this is—it often happens that it is necessary to use very low power objectives, and to obtain a wide field of vision. Many makers have introduced Microscope stands with vertically movable stages, and; these are found in the stands of Messrs. Reichert, of Vienna; Messrs. Beck, Limited, Messrs. Watson and Sons, and Mr. Carl Zeiss, of London, as well as in the Microscopes used by Mr. Sauveur, of Boston, U.S.A.

Cameras.

In my work I have used the camera supplied by Messrs. Nachet et Fils, of Paris, and have found it to be very useful.

Modifications of the vertical cameras are prepared and sold by nearly all Microscope makers.

Horizontal cameras, designed specially for metallography, made by Mr. Carl Zeiss, and Messrs. Beck, Limited, are much to be preferred to the vertical type, the only objection being that they take up much more space.

Illuminators for Opaque Objects.

As all metal objects are opaque, only such devices as throw light on their surfaces are of use in metallography.

The very excellent Sorby Beck oblique and vertical illuminators for low power objectives, have done yeoman service to Micro-metallography in the past, but I would suggest that they would be still more useful if the silver mirrors were replaced by glass. Except perhaps in country places free from smoke, fume and grime, the silver surfaces become tarnished, and it is necessary periodically to remove the reflectors and re-polish them before they can be used.

The internal cover-glass reflector of Beck has been used with much success by most metallographers, but personally I have had trouble in obtaining photographs when illuminating with this arrangement, in consequence of the reflection of vertical rays of light which fall on the surface of the lenses in the object-glass itself. For this reason for several years I have used the Nachet prism reflector, and more recently the prism reflector made by Zeiss, which certainly gives illumination of a very high order and is free from the objection inherent to the cover-glass.

I notice that Messrs. Beck are now supplying a good prism reflector for high power objectives which is fitted with a diaphragm so as to cut off the light to any desirable degree. I have not had an opportunity of trying this instrument, but hope to have that pleasure in the near future.

Messrs. Swift and Sons have prepared to my design a very useful external cover-glass arrangement suitable for $1\frac{1}{2}$ in. to 2 in. objectives. This consists of a tube which is caused to slide over the lower part of the object glass, the bottom part of which is cut at an angle of 45°, and against this a cover-glass $\frac{3}{4}$ in. in diameter is placed and kept in position by small springs. The inner side of the tube is blackened so as to avoid double reflection.

With this reflector working with an ordinary incandescent lamp a photograph of 85 diameters can be taken in 3 minutes when using a No. 3 eye-piece.

Methods of Illumination.

The arc electric light takes the premier place; following it in order are the Nernst light, the acetylene lamp, the incandescent gas burner, the incandescent electric lamp worked at high pressure, and finally the ordinary Microscope oil lamp.

In conclusion, I must express my indebtedness to Messrs. Carling and Son, Middlesbrough, for the loan of their machines and apparatus; to Mr. Plumtree, and to the Union Electric Co. for the use of the motor by which the machinery has been worked, and to Mr. Swift for the loan of microscopes and illuminators.

IV.—*Methods for Detecting the more Highly Phosphorised Portions in Iron and Steel.*

By J. E. Stead, F.R.S.

(*Read March 15th*, 1905.)

Plates V. and VI.

On reading the published researches of micro-metallographers it would appear that very little attention has been paid to the methods for detecting or identifying the more highly phosphorised portions in iron and steel. I have, however, repeatedly had occasion to report upon the structure of steels and to draw attention to irregular distribution of phosphorus.

Signor R. Schanzer, C.E., in a paper read before the Institute of Naval Architects, April 6th, 1900, referred to the peculiar bands of ferrite and pearlite parallel to the axis of a propeller shaft, which he had examined (pl. V. fig. 1.). Every micro-metallographer must have noticed a similar structure.

Professor Arnold and Mr. S. A. Houghton have described them in papers they have published.

Signor Schanzer, when discussing the causes leading to this peculiar arrangement, stated that "nothing can be said as to whether the high amounts of phosphorus are favourable to the development of the particular structure, nor can any other cause be suggested."

That phosphorus is at least responsible in many cases for the arrangement of ferrite and pearlite in trains, lines or bands, I have most conclusively demonstrated, and it appears most probable that Signor Schanzer's inference is correct for the case examined.

Mr. Henry Fay in an article published in "The Metallographist" 1901, page 115, describes a segregation of phosphorus in a piece of cold rolled shafting, in which, after Osmond's polish-attack, midway between the centre and exterior there appeared a white ring on a dark ground. The ring contained 0·214 p.c. phosphorus and the dark portions 0·09 p.c.

Mr. Fay believed the white ring contained some of the phosphide eutectic, but this seems scarcely likely, for it is not until such low carbon steel contains above 1 p.c. phosphorus that the eutectic containing 10·2 p.c. phosphorus separates. Probably the structure observed consisted of alternate portions of steel containing high and low amounts of phosphorus, a condition which might easily lead to the supposition, judging from the appearance alone,

that it was a eutectic, whereas such structure may be produced, as I have found by actual experiment, by the peculiar way in which the phosphorettic parts of steel are imprisoned in and between the crystallites of iron.

I have already published the methods of detecting phosphide in pig-irons by the Microscope; and it only remains for me to describe other methods for differentiating between the portions higher and lower in phosphorus in commercial irons and steels.

The following are detailed directions for applying the several methods.

Heat Tinting Methods.

When polished iron or steel is heated in air the surface becomes coloured by the formation of films of oxide of iron. In proportion as the temperature is raised, or continued at one suitable temperature the tints pass from pale yellow to yellow, brown, purple, blue, and steel grey, and through the same series of tints a second time if the heating is continued, but the tints of the second series are not so intense as those of the first.

Massive carbide of iron becomes coloured less rapidly than iron and more rapidly than phosphide of iron, whilst iron containing phosphorus in solid solution colours more rapidly than pure iron or iron containing less phosphorus.

Method 1.—Into an iron crucible or ladle, or other suitable receptacle, is placed about 4 ounces of tinman's solder (2 tin, 1 lead). The vessel is placed over a Bunsen burner and the solder melted. Into the metal a Le Chatelier couple, covered with a thin piece of asbestos paper, is inserted. The flame of the burner is adjusted until the temperature of the metal stands at 250° C. The specimens, having been polished, are rubbed with a piece of clean woollen cloth, and are warmed on a hot-plate, or in a boiling water oven, and when still warm they are again rubbed with the cloth. They are then floated on the molten metal. The reason for first gently heating is to prevent condensation of acid water from the waste products of the burning gas. If the precaution is not taken the specimen after heating will be covered with minute coloured dots due to condensed steam. The surfaces of the specimens are watched and examined with a strong magnifying glass. They will assume a regular yellow tint, and in a few minutes the phosphorised portions will become brown on a yellow ground, and if the heating is continued they will become coloured blue, whilst the parts not so high in phosphorus will be brown or dark yellow. At this point the specimens are removed and may be examined under the Microscope, whilst still hot. If the tinting is not sufficiently advanced they may be returned to the bath for further heating.

Examples, pl. V. figs. 3, 4, 6.

Method 2.—Instead of regulating the temperature of the bath it may be heated until the surface of the solder begins to form yellow films. Each specimen, preferably of the dimensions 20 mm., by 10 mm. by 5 mm., is, after warming and rubbing with a cloth, held at one end with a pair of tongs, and the under surface of the other end is immersed in the highly heated metal. In one minute or less the tinting will be complete, but it will be graduated in colour between grey at one end and pale yellow at the other; the intermediate part passing through the whole gamut of colouring. The specimens are removed when the central parts have assumed a brown colour.

Treated in this way the phosphorised portions will be dark brown on a yellow ground, or blue on a brown ground.

Method 3.—The specimen is heated rapidly until uniformly blue, and when cold is immersed in water containing a one-thousandth part of nitric acid. The films covering the phosphorised parts will be dissolved in advance, and if the acid treatment is stopped at the right moment it is possible to have white phosphorised areas on a brown or blue matrix. This method gives very satisfactory results, but many failures to obtain the exact development may follow the first attempts. It is sometimes advisable to rub the developed specimen with moistened chamois leather before drying with a hot blast of air (pl. V. fig. 5).

Method 4.—Instead of floating the specimens on the surface of liquid metal, they are placed into a jacketed copper chamber 4 in. in length and 1 in. square, which is surrounded, excepting at one end, with heavy mineral oil, maintained at a temperature of 245° C. A drawer is fitted into this, and into it the metal sections are placed. The tinting by this method of heating is more under control than by the first described, and it is easy to locate the parts highest in phosphorus even in steel castings containing under 0·05 p.c. of that element.

Iodine Etching.

This method is based on the fact that a very dilute tincture of iodine in potassium iodide corrodes the portions lower in phosphorus relatively more rapidly than those containing more of that element.

The necessary reagent contains 1 gramme of iodide and 0·1 iodine per 500 c.cm. alcohol and 50 c.cm. water.

The polished specimens are immersed in this and are examined from time to time. When it is seen that some portions remain brilliantly white on a dull ground, they are removed, washed with water and alcohol, and dried in a current of hot air.

In longitudinal sections of rolled steel after this treatment

there will be seen white lines which may or may not be independent of the ferrite and pearlite areas (pl. VI. fig. 10). These white lines contain the higher proportion of phosphorus. Relatively they resist the corrosive action of the iodine. That this is so may be verified by a longer action followed by slight re-polishing on wet parchment, when, even with the aid of a simple lens, the resist lines will be seen to stand in relief. When examined under oblique light rays, the phosphorised parts appear black on a light ground (pl. VI. fig. 8).

Picric Acid Etching and Tinting Method.

The long-continued action of a 2 p.c. solution of picric acid in water containing 5 p.c. alcohol will colour the portions higher in phosphorus, yellow, brown, blue, etc.

This method is well adapted for the study of wrought iron and soft steel.

When applying the reagent the specimens are immersed in the solution.

The colouring may take several minutes to develop. When it is considered advisable to remove the specimens, they must be washed with water and alcohol, dried in a current of hot air, and on no account must they be wiped with a cloth, for the slightest friction is liable to remove some of the films (pl. VI. fig. 7).

A simple solution of picric acid in water colours the phosphorised portions in advance of the parts containing less phosphorus, but all parts will eventually become brown if the action is continued long enough.

Nitric Acid Etching and Tinting Method.

This method is based on the observation that very dilute nitric acid, like iodine, acts relatively less rapidly on the phosphorised portions, and at first they remain bright, but, if the action is continued, they become darkened by the formation of a dark coloured skin or film. This film is probably of the same substance as the black residue which remains when phosphorised steels are dissolved in dilute sulphuric acid.

On etching longitudinal sections of steel and iron, the phosphorised lines at first resist the acid and appear white on a dark ground, but after longer action the white lines become relatively darker than the less phosphorised parts—indeed, it is possible with care to obtain a positive and negative appearance on the same specimen by a short or more prolonged etching (pl. VI. fig. 9).

After strong etching, if the specimen is re-polished on a cloth block, the phosphorus lines will stand in relief, and as the dark

stain is readily removed by slight friction, the lines appear white on a dull ground.

Professor Heyn has kindly sent me some photographs of steel structures developed by his copper-ammonium-chloride reagent, which appeared to be identical with those developed by iodine. Although he does not describe them as other than indicative of primary crystallisation, I have but little doubt that they are mainly evidence of imperfect distribution of phosphorus.

If steel, containing low carbon, say under 0·5 p.c., in either the cast or forged condition, is very slowly cooled, the highly phosphorised areas reject the carbon which had segregated with the phosphorus, and as a result massive areas of ferrite appear, the borders of which are often surrounded with pearlite.

If the phosphorus is greatly concentrated in certain parts, carbon will not be retained there even on comparatively rapid cooling from a high temperature (pl. VI. fig. 11).

Description of the Photo-Micrographs.

Plates V. and VI.

Fig. 1.—Heavy steel forging showing white parallel streaks, similar to those described by Signor Schanzer, etched with iodine.

Fig. 2.—Photograph of rolled soft steel bar, by Professor E. Heyn, etched with the Heyn reagent. The dark central portion is highest in phosphorus.

	Tensile Strength.	Elongation.
Outer zone . . .	37·0 kg.	25·5 p.c.
Inner zone . . .	42·5 kg.	22·2 p.c.

Professor Heyn states that etching alone enables one to determine that the central portion is highest in phosphorus.

Fig. 3.—Steel casting containing 0·3 p.c. carbon, 0·057 p.c. sulphur, and 0·041 p.c. phosphorus. Heat-tinted to a brown colour. The high lights indicate specks of sulphide of manganese (MnS), the half-tone parts are the boundaries of crystals highest in phosphorus. The dark background is ferrite and pearlite. In the object itself the ground mass is brown, the phosphorised parts are purple, and the sulphide of manganese is white. After forging to one-third of the original diameter, the phosphorised parts appear as bands, and are readily detected by heat-tinting, or by slight etching with iodine.

Fig. 4.—The same steel as fig. 3, to which phosphorus was added when fluid to give 0·3 p.c. Structure developed by heat-tinting. The whiter parts are the boundaries of the primary crystals, and are very high in phosphorus.

Fig. 5.—The same steel as the last, after forging to one-third of the diameter. Heated rapidly to blue and etched with very dilute

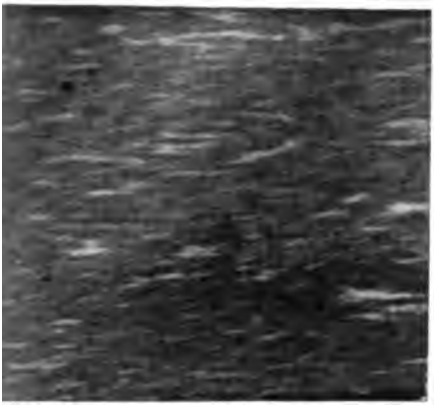

Fig. 1.

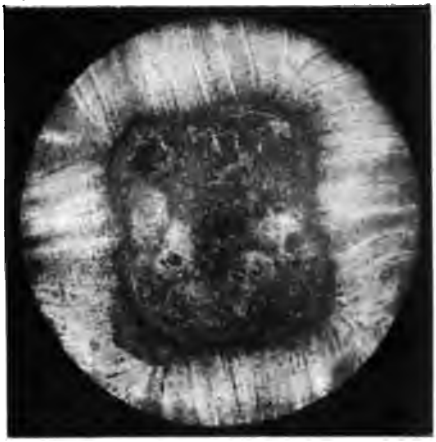

Fig. 2.

Fig. 3.

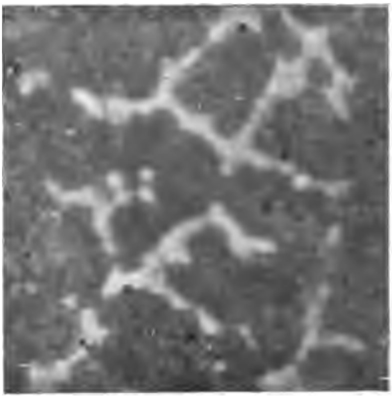

Fig. 4.

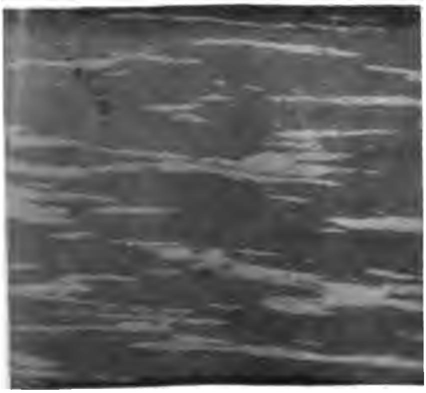

Fig. 5.

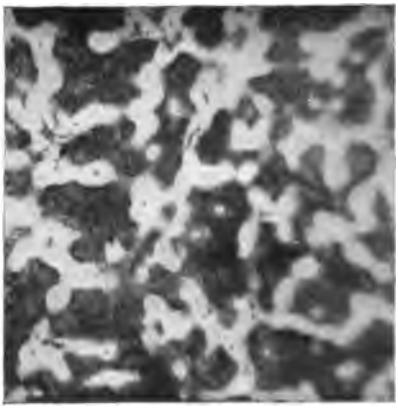

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

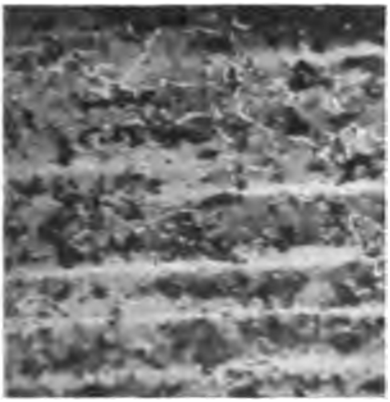

Fig. 10.

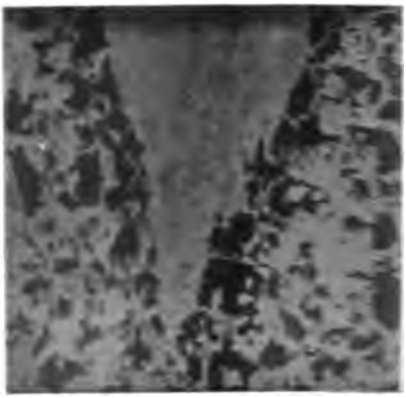

Fig. 11.

nitric acid (Method 3), which leaves the phosphorised portions white on a dark ground.

Fig. 6.—The same steel as fig. 3, but with 0·5 p.c. phosphorus. Heat tinted (Method 1).

Fig. 7.—Plates of pure iron with two bands of iron high in phosphorus between them. Etched by the picric acid method. The dark bands represent the parts high in phosphorus.

Fig. 8.—Alternate plates of pure iron, free from phosphorus, and iron containing 0·25 p.c. of that element. Etched by the iodine method. Illuminated by the oblique light. The pure iron, white, is etched; the phosphorised portions, dark, have resisted the attack.

Fig. 9.—Cross section of a rail-head containing 0·08 p.c. phosphorus. Structure devéloped by the nitric acid method. The dark spots represent minute segregations of phosphorus.

Fig. 10.—Longitudinal section of a steel tyre, containing about C·5 p.c. carbon. Etched with dilute iodine, showing that the resist phosphorus lines pass through the normal ferrite and pearlite areas.

Fig. 11.—Longitudinal section of a heavy crank-shaft, etched slightly with picric acid, showing the terminating point of a phosphorus segregation (white). The carbon has been thrown out of the segregation during annealing, and surrounds it in the condition of pearlite (dark). The segregation appeared as a white line nearly two inches in length, and represents what machinists sometimes call "phantoms" or "ghosts." As a rule these local segregations are accompanied by sulphide of manganese. In one case an approximate analysis indicated 0·35 p.c. phosphorus, 0·5 p.c. sulphur, and no carbon. The surrounding metal had 0·04 p.c. phosphorus and 0·05 p.c. sulphur.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a Embryology.†

Natural and Artificial Parthenogenesis.‡—A. Petrunkevitch takes a retrospect of recent work and discussion on parthenogenesis, and seeks to show how the question now stands. Our knowledge of fertilisation and parthenogenesis may be recapitulated in four statements.

1. Both the egg ready for fertilisation and the mature sperm show a reduction in the number of chromosomes of their nuclei to one half of that found in somatic cells.

2. No matter how many spermatozoa succeed in entering the egg, the nucleus of only one of them, under normal conditions, fuses with the egg nucleus, thus restoring the original number of chromosomes. All other spermatozoa are absorbed.

3. The centrosome of the egg disappears after the second polar cell is formed, its functions being assumed by the centrosome of the spermatozoon.

4. In most parthenogenetic eggs no reduction of chromosomes takes place—only one polar cell being formed—and the egg centrosome remains active.

The spermatozoon may introduce substances apart from its chromosomes and its centrosome; it may be necessary (with Bethe and Bresslau) to distinguish between *Besamung* and *Befruchtung*, but it seems certain that the paternal hereditary characters are transmitted to the descendant by the chromosomes of the sperm-nucleus, and that the sperm-centrosome gives the stimulus to development and controls the successive divisions.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This Section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Amer. Nat., xxxix. (1905) pp. 65–76.

Polyspermy sometimes exists normally, but even then all the spermatozoa save one are normally absorbed by the egg-cytoplasm. If their centrosomes persist they may form independent centres for cell-division, and interfere—sometimes fatally—with normal development. Abnormal development also follows where the egg-nucleus unites with more than one sperm-nucleus. Thus the mere entrance of a spermatozoon into an egg cannot be regarded as in itself the efficient stimulus to normal development. It is possible, by etherising an egg, to prevent the union of the sperm-nucleus with the egg-nucleus, and then one-half of the egg, with the egg-nucleus, develops parthenogetically, while the other, with the sperm-nucleus, develops merogenetically. Therefore Petrunkevitch holds to the old definition of fertilisation, and calls an egg fertilised only when the union of the nuclei is accomplished. Apart from fission, there are three kinds of propagation without fertilisation:—(*a*) budding, through successive regular mitotic divisions proceeding from one or several cells; (*b*) parthenogenesis, from an unfertilised egg, introduced by a maturation division; and (*c*) pædogenesis, as in *Cecidomyia*, which may be larval parthenogenesis or nearer budding, according as a process of maturation does or does not occur, which is still a problem.

In the majority of parthenogenetic eggs—the single exception being that of certain insects—there is but one maturation division and no reduction of chromosomes, the opportunities for variation being thus much restricted. The exception to this rule is found in those insects in which only one sex develops parthenogenetically, and in the male individuals in those cases where both sexes develop parthenogenetically. In such cases two maturation divisions take place with a corresponding reduction in the number of chromosomes.

Microscopic study and that only is able to show without error whether an egg is fertilised or not. The development of an aster around the centrosome of the spermatozoon after it has entered the ovum facilitates the finding of the sperm-nucleus, which keeps its place close behind the migrating centrosome. This sperm-aster develops in the same way throughout the entire animal kingdom; in polyspermic bee-eggs similar asters appear in numbers equalling those of the spermatozoa which enter the egg; in the so-called drone-egg an aster would surely develop should a spermatozoon enter it. In spite of all criticism, the parthenogenesis of the drone-egg remains certain.

In parthenogenetic eggs the egg-centrosome remains active; in *Artemia salina*, at least, we can easily see that it moves alone towards the centre of the egg to await there the nucleus, which, after the single maturation-division, is destined to become the first cleavage-nucleus. Thus does the egg-centrosome in parthenogenetic eggs maintain its individuality through all cell-generations. May it be, however, that in pure parthenogenesis the ostensibly female centrosomes are descendants of a remote ancestral male centrosome?

Still more important biological problems are connected with the behaviour of the chromosomes in parthenogenesis. In pure parthenogenesis they remain unreduced in number; but in the exceptional cases the number is reduced. But Petrunkevitch has shown that the number of chromosomes in the first cleavage nucleus of the drone-egg again

becomes normal; probably through longitudinal splitting without a corresponding division of the cytoplasm. In all parthenogenetic eggs, with possibly the one exception of *Nematus* (according to Doncaster), the number of chromosomes in the first cleavage nucleus becomes in some way equal to that in the somatic cells. It is not impossible that in *Nematus* there is no reduction in spermatogenesis, which would lead to the same thing. Petrunkevitch's attempt to show that the polar cells, after a conjugation similar to that of the pronuclei, give rise to the primordia of the male gonads, requires confirmation.

Experiment must supplement the observation of normal parthenogenesis. Two methods are possible, of which one is cross-breeding and in-breeding, e.g. in bees, and the other artificial parthenogenesis and merogony. In merogony there is a reduced number of chromosomes and the presence of the active sperm-centrosome. In artificial parthenogenesis, there is a stimulation to new life of the egg-centrosome. It may be that there are *de novo* formations of centrosomes, as the research of Yatsu has again emphasised; even then, it is probable that the divisions are due to the egg-centrosome.

According as the stimulus is appplied before or after the second maturation division, we get development with the normal number of chromosomes, or with the reduced number. Both parthenogenetic development with the reduced number of chromosomes and merogonic development show abnormalities, which increase in inverse ratio to the number of chromosomes left in the egg; all this goes to show that neither merogony nor artificial parthenogenesis with a reduced number of chromosomes can be regarded as equivalent to natural parthenogenesis. So Petrunkevitch distinguishes *artificial*, *pathological*, *uniparental development* from *artificial true parthenogenesis* (with the normal number of chromosomes). Experiments must be made by applying the stimulus at the different moments of maturation.

Maturation and Fertilisation of Haminea solitaria (Say).*—W. M. Smallwood gives the results of his embryological investigations upon this mollusc. In the first maturation the chromosomes divide transversely, but in the second maturation it is difficult to ascertain whether the division is transverse or longitudinal. A quantitative, but not a numerical, reduction is accomplished by each of these two divisions. Qualitative reduction cannot be demonstrated. In fertilisation, the sperm head may penetrate the ovum at any point of its surface. A middle piece could not be distinguished. Accessory asters appear in the anaphase of the second maturation, which are temporary and independent of the sperm head. The chromatin in both male and female pronuclei passes through a metamorphosis before the cleavage asters arise. Of the two cleavage asters one is associated in origin with each pronucleus. The centrosome at the close of each cleavage becomes indistinguishable from the microsomes in the cytoplasm, and it is therefore impossible to affirm that it divides in preparation for the following cleavage.

Individuality of the Chromosomes.†—W. J. Baumgartner communicates some observations on the germ-cells of crickets, which furnish

* Bull. Mus. Comp. Zool. Harvard, xlv. (1904) pp. 259–318 (13 pls.).
† Biol. Bulletin, viii. (1904) pp. 1–23 (3 pls.).

two lines of evidence confirming the individuality of the chromosomes. The first of these concerns the accessory chromosome, in whose behaviour he finds additional proof of its distinctness from the other chromosomes. The second line of evidence concerns the ordinary chromosomes. Boveri has recently found a difference *in function* in the chromosomes; Sutton has found a difference *in size;* and Baumgartner has been fortunate enough to find a difference *in form*, a characteristic shape assumed by the chromosomes in the prophase and metaphase of the first spermatocyte division.

Telephase in Blastomeres of Salmonidæ.*—P. Bouin states that the axial filaments which differentiate themselves in the course of the mitoses of the large blastomeres in the Salmonidæ are the following:—(1) A system of fibrillæ extended between the diverging kinetic centres. This is the primary protoplasmic spindle; it disappears when the distance between the centres is considerable. (2) The secondary spindle, a true karyodieretic spindle which is derived from the two regions of the aster directed towards the nucleus. (3) A system of filbrillæ developed between the polar plates. This is the spindle residue in the small blastomeres; it is crushed by the invagination of the cell-membrane during division. (4) A fourth system of filaments is constituted after the disappearance of the before mentioned set. They occupy the whole equatorial region of the mother-cell, and are re-united after the separation of the plasma into a sheaf-like formation. The name "equatorial palisade" (palissade équatoriale) is proposed for these filaments, and separation sheaf (gerbe de séparation) to designate the figure made by them when gathered together by the converging invagination of the cellular membrane.

Morphological Superiority of the Female Sex.†—T. H. Montgomery, jun., reviews a number of facts in the anatomy and development of various invertebrate and vertebrate types, from which he concludes that the male is the more embryonic and less developed. A survey of the facts of sexual dimorphism shows the supposed excellence of the male to consist in what are mainly unimportant morphological characters. The female possesses an internal reproductive apparatus which is generally of much greater complexity than that of the male, and sometimes a central nervous system of higher specialisation. Almost without exception the female is larger than the male. When either of the sexes is rudimentary in comparison with the other, it is in almost all cases the male. The general conclusion reached is that from the standpoint of morphological advancement the female is clearly the superior in the invertebrates and lower vertebrates; and still superior, but in less degree, in the higher vertebrates.

Experiments on Tadpoles.‡—Empedocle Goggio has made a long series of experiments on the tadpoles of the toad (*Bufo vulgaris*) showing the degree of viability and regenerative capacity exhibited after

* Arch. Zool. Exp., iii. (1905) Notes et Revue, pp. xcii–c.
† Proc. Amer. Phil. Soc., xliii. (1904) pp. 365–80.
‡ Atti Soc. Toscana Sci. Nat., xx. (1904) pp. 186–223 (2 pls.).

many different forms of mutilation. His results are remarkable, but he has not as yet formulated any general conclusions.

Spermatozoa of Lamprey.*—E. Ballowitz describes the structure of the spermatozoon in *Petromyzon fluviatilis*, and especially the unique feature, an extremely delicate and long thread ("*Kopfborste*") which arises from the apex of the head. Its morphological character and functional import remain undiscovered.

Function of Interstitial Gland of Testis.†—D. N. Voinov finds that the testes of the adult cock are toxic for animals of the same and different species independently of sex. The genital toxins introduced into the blood produce respiratory, circulatory, and motor troubles, the gravity of which is proportional to the dose; large injections causing death. This toxicity is unrelated to sexual activity, for the effects of the testes of both adult and young animals are the same in degree. These effects are traceable to the interstitial gland, which absorbs the toxins of the blood, preventing them from reaching the seminal elements.

Shifting of Pectoral Fin during Development.‡—H. H. Swinnerton has studied the relative positions of the pectoral fin in an extensive series of stages of the three-spined stickleback (*Gasterosteus aculeatus*). The glenoid border tends to rotate from a horizontal to a vertical position during development. The immediate cause of the shifting of the fin is to be found in the fact that the coraco-scapular plate is at first a very insignificant portion of the pectoral skeleton, but as development advances it broadens out antero-posteriorly. In view of the phylogenetic shifting forwards of the pelvic fin in Teleosts, it would be instructive to ascertain if there is a corresponding phylogenetic shifting back of the pectoral fin.

Influence of Castration on Size.§—E. Pittard submits statistics which lead him to conclude that castration results in an increase of the absolute size in human groups, that the bust contributes very much less than the legs to the exaggerated development—in fact, there is a relative diminution in the development of the bust and a relatively large increase in the legs.

Development of Vascular System of Ceratodus.‖—W. E. Kellicott gives a summary of the chief results of his study of the development of the vascular system in *Ceratodus*; the general conclusion is that the resemblances in the vascular (and respiratory) systems between this most primitive representative of the extant Dipnoi and the Amphibia, especially the Urodela, are numerous and fundamental, and cannot be explained as parallelisms.

Studies in Bone Development.¶—H. Meyburg has investigated certain points in the development of bone, particularly the stage described by Gebhardt as "in toto konzentrischen Struktur." Succeeding

* Arch. Mikr. Anat., lxv. (1904) pp. 96–120 (1 pl.).
† Arch. Zool. Exp., iii. (1905) Notes et Revue, pp. lxxxi.–xcii.
‡ Ann. Nat. Hist., xv. (1905) pp. 319–21 (4 figs.).
§ Comptes Rendus, cxxxix. (1904) pp. 571–3.
‖ Anat. Anzeig., xxvi. (1905) pp. 200–8 (2 figs.).
¶ Arch. Mikr. Anat., lxiv. (1904) pp. 627–52.

the rudiment of the diaphysis of the tubular bones in mammals is a stage which consists of laminæ arranged concentrically round the whole skeletal part. The interstices between these laminæ are likewise concentric, and are occupied by a corresponding concentric network of blood vessels. These spaces are later filled out with delicate non-lamellate bone substance, which has a preponderatingly "in toto concentric" arrangement, whilst, observed in detail, it is seen to be deposited concentrically about the single vessel groups. This characteristic arrangement, which persists in different animals for different periods, entirely disappears, and is replaced by a structure formed of general lamellæ and Haversian pillars, which is likewise "in toto concentric." Roux distinguishes the two stages as "primary" and "secondary in toto concentric" respectively. The paper gives an account of the subsequent changes resulting in the well-known compact diaphyses, as well as the different degrees occurring in various animals and in particular bones.

Lumbar Spinal Cord in Birds.*—G. Imhof. gives an account of the structure and development of the lumbar spinal cord. The lumbar dilatation, together with the widened pelvic canal, is a secondary acquisition of a relatively late period of embryonic life. It reaches in the histological differentiation of its supporting substance, a stage not possible in modern reptiles, not to speak of Mesozoic forms. The author regards the view that the lumbar swelling in birds is a character inherited from Dinosaur ancestors as quite untenable.

Notes on Opisthenogenesis.†—A. S. Packard discusses, with the help of some examples which have come under his personal observation, the question of the development of segments, median tubercles, and markings *a tergo*. Opisthenogenesis, as regards markings, appears to have some relation with the opisthenogenetic origin in post-embryonic development of new segments in "the budding zone." The portion of the animal which arises from this zone appears to be a secondary or inherited region, due to the post-embryonic acquisition of new characters (certain trunk segments and their appendages) in many segmented or polymerous animals. It is suggested that the phenomenon of concrescence may be the initial cause, or at least in some way connected with the breaking up of the longitudinal stripes of the body and their transformation into spots at or near the budding zone of their polymerous or polypodous (*Peripatus*-like) ancestors.

b. Histology.

Studies on Neuroglia.‡—W. Rubaschkin has investigated the origin, nature, and relations of neuroglia, with the following results. It consists of fibres and different kinds of cells genetically related. The earliest gliagenetic cells are distinguished by their size and granular cell-body with granular prolongations. The gliagenetic cells are the beginning of all elements of the neuroglia, and form by the metamor-

* Arch. Mikr. Anat., lxv. (1905) pp. 498–610 (1 pl.).
† Proc. Amer. Phil. Soc., xliii. (1904) pp. 289–94.
‡ Arch. Mikr. Anat., lxiv. (1904) pp. 575–626 (4 pls.).

phosis of their prolongations and of their protoplasm the different elements. The differentiated prolongations assume the character of glia fibrils; from a single prolongation there probably arise several fibrils, some of which remain in connection with the cell, whilst others become free. The last stage of the glia metamorphosis consists of cells without prolongations, and astrocytes (which probably remain stellate), with differentiated prolongations and differentiated cell-body (*Astrocyten des Endtypus*). The cell-body of many full-grown stellate cells, but especially of this type of Astrocyte, is provided with comb-shaped elevations, which on staining behave as glia fibrils. Round the vessels the glia fibres form a more or less thickly interlacing net, similar to glia adventitia, and, together with the continuations of the stellate cells, they form around the nerve-cells and fibres a more or less close network, the glia capsules, but penetrate neither into the interior of the nerve-cells nor of the myelin. Especially rich in glia are the optic nerve, chiasma, optic tract, and olfactory nerve, while the roots of the spinal nerves are provided to a definite extent with glia fibres. An account is also given of the structure and composition of the ependyme, of the continuations of the cells of the ependyme epithelium, and of the infundibulum.

New Nerve Sheath in Sensory Nerves.*—A. Ruffini has found a new nerve sheath, between Schwann's and Henle's, in the terminal tract of the sensory nerve-fibres in man. He regards it as protective in character, calls it the *guaina sussidaria*, and describes it in detail.

Peripheral Cell-Groups in Spinal Cord of Reptiles.†—A. I. Sterzi discusses the peripheral cell-groups which occur throughout the whole length of the spinal cord in reptiles, metamerically arranged beside the spinal roots, arising in development from the ventral column, and motor in function. They may be compared to the spinal ganglia.

Olfactory Cells of Lamprey.‡—E. Ballowitz gives a detailed account of the minute structure of the olfactory cells in *Petromyzon fluviatilis*, describing the peripheral protoplasmic body, which bears long cilia, and the central nerve-process, which pursues an irregularly curved course between the loose basal portions of the supporting cells, and shows varicosities.

Endocellular Tubules.§—Domingo Sanchez has previously directed attention to what he regards as fine intra-cellular tubules in the intestinal cells of certain Isopods. He returns to this subject and discusses intra-cellular tubule (*a*) in the unicellular glands, (*b*) in intestinal epithelium, and (*c*) in ganglion cells. These represent three distinct groups of intra-cellular tubules which must be separately discussed. The author's new instances are chiefly from the intestinal cells of slugs and snails.

* Zeitschr. wiss. Zool., lxxix. (1905) pp. 150-70 (2 pls.).
† Atti Soc. Toscana Sci. Nat., xx. (1904) pp. 243-75 (2 pls.).
‡ Archiv Mikr. Anat., lxv. (1904) pp. 78-95 (1 pl.).
§ Boll. Soc. Españ. Hist. Nat., iv. (1904) pp. 375-9 (2 figs.).

Structure and Regeneration of Poison Glands of Plethodon oregonensis.*—C. O. Esterly finds that the skin glands of this newt are of two kinds, as in most amphibians, namely granular and mucous. The granule glands are larger than the mucous glands, have an investing musculature, and are poisonous. They are destroyed in the process of secretion, and renewal takes place by the growth into all the old glands of a new and smaller gland, which is mucous in character. The growth of the new gland is dependent upon the removal of the secretion about it. There is evidence that even when hindered in their development, they still secrete mucus, and a primordium giving the mucous reaction is found in all glands whether degenerate or not. When not hemmed in by the heavy granular contents of the large glands, the new glands grow and replace the old glands, probably assuming their function.

Both the musculature and the epithelium of the granule glands have a direct nerve supply. The gland cells are surrounded by a basket-work of fibres, which in some cases have terminal expansions lying on the nuclei. The muscles are supplied by nerves with typical endings in the form of expansions or bulbs, as well as by fine twigs without terminal expansions.

Intranuclear Fat in the Supra-renals of Mammals.†—P. Mulon finds in some mammals, e.g. guinea-pig and dog, both young and adult, that the nuclei of the cells of the cortical substance show fatty inclusions. The nuclei are quite normal in form and as to their chromatin. The presence of fat in the nuclei, i.e. in a phosphatic environment, is the more remarkable, since the cytoplasm of these glandular cells contains a lecithin. The presence of inclusions of the same chemical nature in the nucleus and in the cytoplasm of secreting cells suggests that the nucleus has an active role in the secretory process.

Supra-renal Capsules.‡—Rivas Mateos, C. Calleja, and R. Folch give a summary account of their observations on the minute structure of the supra-renal capsules in mammals, discussing in order the connective-tissue zone, the cortical zone, and the medullary zone.

Heart Muscle of Dog.§—Gertrude A. Gillmore finds that in the dog's heart the fibres are packed closely together. Fibrils from adjacent cells blend together to form new fibres. Along the edge of the fibres there is a narrow wavy condensation of sarcoplasm resembling the sarcolemma of insect muscle. In this structure Krause's membrane terminates. Numerous other details of structure are discussed in the paper.

c. General.

Pelagic Cephalochordates.‖—R. Goldschmidt obtained from the 'Valdivia' collection 26 specimens of pelagic Cephalochordates captured

* Univ. California Publications (Zoology) i., No. 7 (1904) pp. 227–63 (4 pls.).
† Comptes Rendus, cxxxix. (1904) pp. 1228–30.
‡ Boll. Soc. Españ. Hist. Nat., iv. (1904) pp. 262–4.
§ Trans. Amer. Micr. Soc., xxv. (1904) pp. 35–44 (3 pls.).
‖ Biol. Centralbl., xxv. (1905) pp. 235–40 (1 fig.).

in circum-equatorial waters in the Atlantic, Pacific, and Indian Oceans. The collection included Günther's *Branchiostomum pelagicum* and two new species. All must be referred to the genus *Amphioxides* Gill, for which the new family Amphioxididæ is proposed. The diagnosis reads as follows :—Pelagic Acrania without peribranchial space, with a slit-like mouth lying to the left, with branchial slits on the ventral median line, with the pharynx divided into a dorsal nutritive, and a ventral respiratory portion. In *Amphioxides pelagicus* (Günther) the notochord runs to a point at the caudal end, and there are 15 post-anal myotomes; in *A. valdiviæ* sp. n. the notochord ends bluntly in front of the caudal end, and there are 11 post-anal myotomes; in *A. stenurus* sp. n. the myotomes are 55 pre-anal and 15 post-anal, and the posterior end is very much narrowed. The author promises to discuss these forms in detail, and to show why they cannot be regarded as neotænic larval forms.

Eye of Bdellostoma stouti.*—B. M. Allen recalls the observations of Johannes Müller, who noted the absence of eye-muscles, the lack of a crystalline lens, the homogeneous character of the eye-capsule, and the total absence of pigmentation in the eye-structures. By means of serial section, Allen has amplified these observations. The eye is imbedded in a mass of fat lying beneath a transparent patch of skin on the side of the head; no traces of eye-muscles are to be seen, and Kupffer found none in the embryo. A slender optic nerve can be traced through the mass of fat to the eye-ball. In some cases, the eye is wholly imbedded, not reaching to the surface of the mass of fat; in other cases, the corneal portion is flattened against the integument.

The size and shape of the eye-ball, the thickness of the retina, and the presence or absence of a persistent choroid fissure, are subject to great fluctuation.

A section of the eye shows the sclerotic and choroid coats, together with the inner layer of the cornea, to consist of a homogeneous unpigmented layer of connective tissue. The optic cup remains in a primitive condition. The inner layer is not directly apposed to the outer, there being a distinct interval between the two. The inner layer shows more or less clearly marked retinal cells; the outer layer is composed of a single layer of unpigmented cubical cells.

Nervous System of Cyclothone acclinidens.† — August Gierse has made a study of the brain and cranial nerves of this small pelagic deep-water Teleostean, and finds that there are divergences in several respects from the common condition of affairs in bony fishes. The skull is a persistent chondrocranium; the whole skeleton is cartilaginous; there are no scales. The brain is long and narrow; the cerebral hemispheres are inconspicuous; the thalamencephalon is exposed; there are two independent epiphyses; there are two symmetrical pineal nerves; the parapineal organ is a simple evagination of the *ventriculus communis* with a terminal spindle-shaped expansion in close apposition to the pineal organ; the connection between hypophysis and infundibulum is a solid nervous strand; the mid-brain is strongly developed, but with an im-

* Anat. Anzeig., xxvi. (1905) pp. 208–11 (11 figs.).
† Morphol. Jahrb, xxxii. (1904) pp. 602–88 (3 pls.).

perfect roof; the cerebellum resembles that of *Argyropelecus*, and is primitive in the slight development of the *valvula cerebelli*; the medulla is essentially like that of other fishes. The cranial nerves are described at length.

Pairing of Rana temporaria.*—W. Wolterstorff records some interesting facts concerning *R. temporaria*, observed by Dr. Dieck on an expedition in Asturias. In a pass (1400 m. high) between Leon and Oviedo, he observed thousands of gigantic well-nourished reddish-brown frogs in copula upon the snow. They were progressing towards a brook which was just thawing. It appears that they pass the winter under the snow; under the sexual impulse they scrape out channels through which they reach the surface and make for the water.

Types of Limb-Structure in Triassic Ichthyosauria.†—J. C. Merriam discusses the four types of limbs known in the Triassic Ichthyosaurs. They show an unexpected degree of differentiation when compared with the limbs of Jurassic genera. But in spite of the differentiation shown in the Triassic types, they have all retained certain primitive characters not common in the later forms. All show a separation of radius and ulna, and in all excepting *Shastasaurus osmonti* these elements are elongated and the radius is constricted or shafted. The presence of these and other primitive characters in so many otherwise different forms furnishes us with much stronger evidence of the origin of the Ichthyosauria from generalised shore forms than could have been given by the single type known to Baur, who nevertheless reached the conclusion that the limbs of the Triassic Ichthyosaurs come nearer to the type found in the primitive Reptilia than do those of the later representatives of the order, and argued that the group bore the same relation to the Rhynchocephalia that the cetaceans bear to the primitive mammals.

Ear-Bones of Vipera and Tropidonotus.‡—W. Möller has investigated the development and innervation of the ear-bones in these two forms by means of reconstructions from serial sections of embryos. The columella arises from the caudal end of the capsule which develops around the membranous labyrinth. From this it grows as a conical projection towards the hyoid arch, to end near the outer opening of the first gill-cleft. In the beginning there is no clear distinction between the origin of the columella and the rest of the labyrinth capsule. At all the stages examined the columella was of uniform structure throughout, and nothing to indicate its formation in two parts was found. The tuberosity at the hinder end of the quadrate observed by Hassa is probably a stylo-hyal which has fused with it. This stylo-hyal, the author finds, is united by a joint with the columella. Peculiar granule-bearing cells were observed around the columella at the stage of formation of the primitive cartilage. Numerous details regarding innervation are given in the paper.

* Zool. Anzeig., xxviii. (1905) pp. 536–8.
† Amer. Journ. Sci., xix. (1905) pp. 23–30 (7 figs.).
‡ Arch. Mikr. Anat., lxv. (1905) pp. 439–97 (2 pls.).

Epidermal Organs in Lizards.*—F. Fölg has made a comparative histological examination of the femoral, pre-anal or inguinal, and anal organs in *Lacerta*, *Agama*, and other lizards. These organs all show a more or less marked agreement with the epidermis, and are not of a glandular nature.

Reptilian Lower Jaw.†—J. S. Kingsley discusses the composition of the lower-jaw in reptilian types. A good deal of confusion has arisen, since Cuvier recognised at most six component bones (1836). In an embryo of the lizard *Sceloporus*, in which the centres of ossification have appeared, reconstruction from serial sections shows the following elements: most posteriorly a long and slender dermarticular, the articular, the angular, the splenial, the coronoid, the dentary, and the surangular. The only difference between Cuvier's account and that given by Kingsley is the recognition of the dermarticular as a distinct element. In the lizard it afterwards fuses with the articular, but in some reptiles it is distinct throughout life. Its characteristics are its position on the posterior inner side of Meckel's cartilage, its inferior margin being overlapped by the angular and its anterior end, which lies ventral to the coronoid, by the splenial element.

Classification of Birds.‡—R. W. Shufeldt gives his classification of the higher groups down to and including the families of birds. The divisions employed are Order, Super-sub-order, Sub-order, Family. No details are given, but the paper discusses in a general way the value of various criteria in classification.

Rudimentary Upper Canines in Elk.§—E. Lönnberg describes in an old male of *Alces alces* a pair of rudimentary canine teeth, which were imbedded in the firm connective tissue of the soft palate, and not implanted in alveoli. They were quite short, without fang, and in shape resembled the crown ends of the "hooks" of red deer.

Perineal Sac in Cavia cobaya.‖—S. Grosz describes in both sexes a perineal sac, into which two sebaceous glandular bodies open. These glands are markedly developed in the male, less so in the female. The author is of opinion that this apparatus is related to the sexual function, and effects attraction between the sexes.

Arboreal Ancestry of Mammalia.¶—W. D. Matthew discusses the probable origin of the mammalia, postulating a common ancestral group from which all known mammals, excepting the Prototheria, are descended. The evidence for such a group is the close uniformity of these mammalia in general structure, in spite of their wide divergence in adaptive specialisation, and the invariable approximation towards a central type of each race whose development is known from palæontology. He enumerates with considerable detail the characters of this primitive

* Arbeit. Zool. Inst. Wien, xv. Heft 2 (1904) pp. 7–36 (3 pls.).
† Amer. Nat., xxxix. (1905) pp. 59–64 (8 figs.).
‡ Op. cit., xxxviii. (1904) pp. 833–57.
§ Zool. Anzeig., xxviii. (1905) pp. 448–9.
‖ Zeitschr. wiss. Zool., lxxviii. (1904) pp. 261–7.
¶ Amer. Nat., xxxviii. (1904) pp. 811–18.

central type, in which he assumes opposability of the first digit in both manus and pes, and an arboreal habit. The earliest divergence from the type is placed in the middle or upper Cretaceous. The various modern arboreal groups (monkeys, squirrels, arboreal insectivores, opossums) are the least altered in structure, while the amount of structural change in other groups, as shown by their known palæontology, is proportioned to the change in their mode of life, the Ungulata exhibiting the greatest changes.

Orkney Vole.*—C. J. Forsyth Major points out that *Microtus orcadensis* discovered by Mr. Millais in the Orkneys and certain parts of Shetland most closely approaches *M. arvalis*, one of the field-voles of Continental Europe and Northern Asia. It certainly belongs to the *M. arvalis* group, and that *group* (if not the *species M. arvalis*) was represented in Britain during Pleistocene times. This last circumstance will in due time presumably help to explain satisfactorily the present existence of a member of the *M. arvalis* group in the Orkney and Shetland Islands.

Cave Faunas.†—Armand Viré has made a special study of this subject, and finds, amongst other things, that the fauna of caves is essentially a mixture of two types. One is manifestly representative of the existing fauna outside; the other has no relations in existing fresh waters, but seems to have arisen from species now everywhere else extinct.

Tube Plan of Structure of the Animal Body.‡—J. S. Foote, in an extremely interesting paper, demonstrates the tube character of most of the organs of the body, classifying them as four-, three-, two-, single-coated, and one-layered tubes. Four-coated tubes, e.g. alimentary tract, are adapted to the progressive motion of their contents and to the application of their epithelial structures to the contents. Three-coated tubes are adapted to the progressive motion of their contents when necessary, e.g. fallopian tube. Two-coated are adapted to conditions requiring an open tube, as trachea and large bronchi. Single-coated tubes are adapted to functions of secretion and special sense, while one-layered tubes are adapted to osmotic conditions. By a simple method of construction explained in the paper, different organs can be built up and their nature and functions deduced from the various layers and combinations employed.

The Thermocline and its Biological Significance.§—E. A. Birge reviews a number of facts bearing on the biological significance of the thermocline or *Sprungschicht*. This is defined as the comparatively thin stratum in the water of a lake, situated below the surface, in which the temperature falls rapidly—much more rapidly than in strata of similar thickness above or below it. It is to be fairly inferred that the thermocline constitutes a critical point in the distribution of the plankton in the water below the surface. No single factor within the water itself

* Ann. Nat. Hist., xv. (1905) pp. 323–4.
† Comptes Rendus, cxxxix. (1904) pp. 992–5.
‡ Trans. Amer. Micr. Soc., xxv. (1904) pp. 65–86 (6 pls.).
§ Tom. cit., pp. 5–33.

compares with it in importance. The direct influence of the change of temperature is not very great, and in this respect the difference of temperature in the lake corresponds to temperature-differences in general. Most plants and animals of temperate regions are not particularly sensitive to a change of a few degrees of temperature. For some species, however, the change from warm to cool water constitutes the factor which determines their vertical distribution. Indirectly, the effect of the thermocline is far greater. The stagnation of the lower water, with its attendant chemical results, causes a sharp limitation of the distribution of the animal life in many lakes. The thermocline in these lakes marks the limit of the thriving of algæ and thus directly limits the distribution of plants and indirectly that of the animals which feed upon them. In all lakes the thermocline has an evident influence upon distribution, and although it is by no means an impassable barrier, most species of plankton animals live, by preference, either above or below it.

Origin of Markings of Organisms.*—A. S. Packard discusses his theory that the markings of organisms are due to the physical rather than the biological environment. The alleged cases of Müllerian mimicry can be explained by convergence due to such causes. He regards the attacks of birds upon insects as a negligible factor. Resemblances in coloration and markings are the result of pigmentation caused by exposure to the combined effects of sunlight and shade. They are due to the repetition of the fundamental colours, brown, black, red, yellow, in insects of different orders, as well as animals of different classes, living exposed to direct sunlight, and often having exceptional diurnal or light-loving habits in contrast to the lucifugous habits of the other species of the genus, family or order. The similarity of design appears in many, if not most, cases to be due to the repetition of markings with identical shapes or patterns, i.e. lines, bars, which are eventually broken up into spots and repeated *ad infinitum*, owing to the economy of material and design, differing in detail in different groups owing to their different origin and hereditary constitution. Such markings probably gradually arose in a given region simultaneously in all the individuals, and not as a variation in a single individual, which is supposed to have been favoured in the struggle for existence. While the initial causes, therefore, are Lamarckian, natural selection as a preservative process may form a subordinate factor. It is pointed out that stripes, bars, and spots occurred on the wings of Palæozoic insects which flourished before the appearance of birds and even of modern types of lizards.

Pre-Aristotelian Zoology.†—Rudolph Burckhardt gives an analysis of the zoological or dietetic part of the Corpus Hippocraticum and compares what he calls "das koische Tiersystem" and "die knidische Tierfolge" with Aristotle's classification. After careful consideration he comes to the conclusion that although there were pre-Aristotelian hints at orderly arrangement, Aristotle was the first to consciously employ the principles of zoological taxonomy.

* Proc. Amer. Phil. Soc., xliii. (1904) pp. 393–450.
† Verh. Nat. Ges. Basel, xv. (1904) pp. 377–414.

Tunicata.

Archiascidia neapolitana.*—Ch. Julin gives a detailed description of this interesting new type, the most archaic of known Ascidians, nearest the hypothetical ancestor *Protoascidia*. It is like the young oozooid of *Clavelina* in many ways, but it is sexually mature and has no epicardium. On each side of the thorax there are two rows of branchial stigmata, much elongated, separated by a transverse sinus, and arising from two branchial clefts, appearing one behind the other. There is no epicardium, but throughout the length of the abdomen there is a frontal partition of peribranchial origin dividing the abdomen into a larger dorsal and a more restricted ventral sinus. In the nature of the intestinal gland, in the structure of the gonads, and in many other ways, *Archiascidia* is true to its name. A new family Archiascidiidæ is required.

Mesoderm Formation and the Structure of the Tail in Ascidian Larvæ.†—Philipp Heinemann has studied the development of *Ciona intestinalis*, *Clavelina lepadiformis*, and *Molgula nana*, with especial reference to the origin of the mesoderm and the structure of the tail. He agrees with Kowalewsky and Seeliger that endoderm-cells lying laterally below the nerve-cord and the ectoderm give origin to the mesoderm; he disagrees with the view of Davidoff that an endoderm-cell divides into a mesoderm-cell and another endoderm cell, with the view of Van Beneden and Julin that diverticula from the enteron form the mesoderm primordia, and with one of Castle's conclusions that in the *posterior* region of the body the mesoderm has an *ectodermic* origin.

In the three forms studied the "tail" is composed of similar parts, namely the peripheral fin-fringe, a central notochord, the nerve-cord, the two muscle-bands, and an endodermic process.

Dolchinia mirabilis.‡—A. Korotneff described more than ten years ago a remarkable Tunicate from Naples which he named *Dolchinia mirabilis*. In passing through Naples in 1903 he was fortunate enough to find that his discovery had re-occurred in abundance. It had only once been found in the intervening decennium.

The form in question is a gelatinous and transparent tube almost covered with salpiform individuals fixed to the surface by stalks which are readily detached. In his first specimens Korotneff found only one kind of zooid, but in the second set he found a second type with a marked resemblance to the lateral form of *Doliolum*. He gives a detailed description, and shows that *Dolchinia* must be ranked phyletically alongside of *Doliolum*.

INVERTEBRATA.

Mollusca.

Myocardium in Primitive Molluscs.§—P. Vigier and Fr. Vlès have studied the minute structure of the myocardium in one of the Amphi-

* MT. Zool. Stat. Neapel, xvi. (1904) pp. 489–552 (1 pl.).
† Zeitschr. wiss. Zool., lxxix. (1905) pp. 1–72 (4 pls.).
‡ MT. Zool. Stat. Neapel, xvi. (1904) pp. 480–8 (1 pl. and 2 figs.).
§ Comptes Rendus, cxxxix. (1904) pp. 1226–8.

neura (*Acanthochites fascicularis*) and in the protobranch *Nucula*, and show that the degree of differentiation does not in general correspond with phyletic position. It has of course to do with the functional activity of the heart, which differs even among related forms in correspondence with the conditions of life. In the Chiton the musculature of the heart consists of a plexus of fibrils which do not form individualised fibres. Most of the fibrils are simply striated; a few show compound striation, and some appear homogeneous. In the protobranch the musculature is feebly developed; there are a few delicate bundles of simply striated fibrils; there are no definite fibres.

Histology of Molluscan Heart-Muscle.*—P. Vigier and F. Vlès have failed to find any relation between the perfection of striation of the heart-muscle of molluscs and the phylogeny of the group. The degree to which it exists in particular forms has a purely functional significance, and it is suggested that the striation described by Marceau in the heart of *Octopus* is not characteristic of Cephalopods in general.

α. Cephalopoda.

Egg-Envelopes in Cephalopods and Chitons.†—A. Schweikart describes the formation of the egg and the follicle-cells in Cephalopods, the three ovarian egg-envelopes in *Todaropsis veranii* and *Eledone moschata*, the peculiar conditions seen at the animal pole of the egg of *Eledone* when the micropyle is being formed, the development of the true chorion from the follicular epithelium in *Sepiola rondeletii*, and the formation of the micropyle in *Rossia macrosoma*.

In five species of Chitonidæ the ovum first acquires a chorionic membrane as a secreted product of the follicular cells, and afterwards a vitelline membrane which arises as a peripheral hardening of the peripheral zone of the egg-cytoplasm.

γ. Gastropoda.

Physiological Studies on Aplysia.‡—W. Straub shows how well this mollusc is adapted for physiological studies on heart-beats, blood-pressure, respiration, innervation, and so on. His communication is simply an illustration of physiological method applied in a more or less unexplored field.

New Genus of Solenogastres.§—H. Heath describes a new genus from Alaska, *Limifossor*, g. n., and species *L. talpoideus*, sp. n. In the arrangement of the organs in the posterior end of the body, the form described resembles *Chætoderma*, but in several important characters it differs. The body is short; the radula is very large, of the distichous type, with 28 transverse rows; dorsal salivary glands are present; stomach and liver are well-developed and distinct from the relatively long slender intestine.

* Bull. Soc. Zool. France, xxix. (1905) pp. 221–9.
† Zool. Jahrb. Suppl., Heft vi., Fauna Chilensis (1904) pp. 353–406 (4 pls. and 2 figs.).
‡ MT. Zool. Stat. Neapel, xvi. (1904) pp. 458–68 (1 pl. and 5 figs.).
§ Zool. Anzeig., xxviii. (1904) pp. 329–31.

Germinal Localisation in Patella and Dentâlium.*—E. B. Wilson gives an account of experiments on the development of isolated blastomeres which establish definitely the principle of mosaic development in the case of these molluscs. The evidence in *Patella* that the cleavage cells are definitely specified from the time of their first formation, and that they undergo self-differentiation without essential modification through their relation to the other cells, is demonstrated in the cells of the first quartet, at least as far as the 16-celled stage. The entire first quartet of *Patella*, when isolated, produces a mass of ectoblast cells, which, though it closes, does not gastrulate, but undergoes essentially the same differentiation as if it formed the upper hemisphere of a complete larva. The foregoing and numerous analogous facts constitute a strong body of *prima facie* evidence that the entire cleavage-pattern in the molluscan egg represents (with certain specified reservations) a mosaic-work of self-differentiating cells, exactly in the sense of Roux's general conception. Similar conclusions have been arrived at from a study of the germ regions in the egg of *Dentalium*.

Cephalopyge trematoides.†—Elise Hanel describes under this title a new Nudibranch which Chun found on a voyage to the Canaries and recorded ‡ as a species of *Phyllirhoë*. Some specimens were found free, and two were found attached by a ventral suctorial process under the head to colonies of *Halistemma*. Hanel's more detailed observation of this interesting form shows that it cannot be regarded as a species of *Phyllirhoë*. It has a foot-gland, for instance, and the anus opens on the head; it is a connecting link between the divergent Phyllirhoidæ and the other Nudibranchs.

δ. Lamellibranchiata.

Artificial Parthenogenesis in Mactra.§—K. Kostanecki finds that the addition of potassium chloride to the sea-water induces some degree of parthenogenetic development in the ova of *Mactra*, and he has studied the details of nuclear change in the formation of the directive and segmentation divisions. He confirms Boveri's conclusion that the artificial stimulus evokes the formation of new centres in the cytoplasm, corresponding physiologically to the centrosome normally introduced by the spermatozoon. In certain conditions the artificially induced directive divisions are exactly like those in fertilised ova. The formation of the division-centres for the segmentation spindle occurs apart from the centriole left after the liberation of the second polar body; it seems to arise *de novo* in intimate association with the nuclear framework. The formation of this "intra-nuclear spindle," without polar radiation, without central granules, with the two poles defined simply by the convergence of the spindle-fibres, and leading on by "intra-nuclear karyokinesis" to the appearance of two daughter-nuclei, must be regarded as one of the most striking phenomena in the artificially induced parthenogenetic process.

* Journ. Exper. Zoology, Baltimore, i. (1904) pp. 1–72, 197–268.
† Zool. Jahrb., xxi. (1905) pp. 451–66 (2 pls.).
‡ S.B. Akad. wiss. Berlin, 1888, p. 28.
§ Bull. Internat. Acad. Sci. Cracovie, 1904, pp. 70–91.

Locomotion of Nucula.*—Fred Vlès has made a careful study of the movements of *Nucula nucleus*. When its pedal disc is extended the upper surface of the plantar sole becomes concave in the sand, and the animal draws itself towards this anchor. The precise details require a diagram for their exposition. In Gastropods and most Lamellibranchs the locomotion is a backward propulsion from the under or latero-inferior aspect of the foot; in *Nucula* the process is almost the direct opposite of this.

Arthropoda.

a. Insecta.

Maturation in Viviparous Aphides.†—J. P. Stschelkanovzew finds that the maturation changes of the chromatin substance in the summer ova of *Aphis rosæ* take place with great rapidity and in a somewhat simplified fashion. The "stage of the germinal vesicle" is distinctly recognisable; the old chromatin-thread is partially dissolved; it seems to break up into several nucleoli, but the majority of these arise by new formation. During the formation of nucleoli there seems to be a passage of a chromatin-like substance from the cytoplasm of the ovum into the nucleus, probably to form, through the mediation of the nucleolar substance, organised chromatin. The new chromatin-thread, from which the chromosomes of the polar body arise, is formed directly from the peripheral nucleoli, and shows no trace of longitudinal splitting.

Primitive Thysanuran.‡—F. Silvestri describes *Anajapyx vesiculosus*, which is even more primitive than *Projapyx*, and is also remarkable as a synthetic type. It combines characters of Symphyla and Diplopoda (the pre-anal glands and the ventral vesicles), of Campodeidæ (the subcoxal appendices on the internal side of the stiles of the first urosternite, the form of the inferior labrum and of the stiles), of Japygidæ (the presence of stiles on the first urosternite, the form of the maxillæ, the same number of stigmata as in *Parajapyx*, and the longitudinal anastomosis of the tracheæ), and of Lepismatidæ (the longitudinal and ventral anastomosis of the tracheal system and the strong development of the anterior intestine).

Protective Resemblance in Insecta.§—Mark L. Sykes gives a very full account of the phenomena upon which Müller's theory of mutual protection, and Bates's theory of mimicry, are based. Numerous striking illustrations are given; most of the examples are selected from amongst the tropical fauna, but it is pointed out that the British Insecta include amongst their numbers in all stages, many varied and beautiful examples of protective resemblance.

Structure of Tracheate Syncerebrum.‖—B. Haller reviews in an exhaustive manner the plan of structure and relations of the tracheate syncerebrum. Very generally and briefly it may be stated to consist of

* Bull. Soc. Zool. France, xxix. (1904) pp. 191–6 (5 figs.).
† Biol. Centralbl., xxiv. (1904) pp. 104–12 (7 figs.).
‡ Ann. R. Scuola Agric. Portici, vi. (1905) p. 15 (12 figs.).
§ Proc. Manchester Field Club, 1904, pp. 183–234 (11 pls.).
‖ Arch. Mikr. Anat., lxv. (1904) pp. 181–279 (6 pls.).

three divisions, proto-, deuto-, and trito-cerebrum. These are blended into one in the Myriopoda. The three divisions correspond to three sense spheres; the protocerebrum to that of the eyes, the deutocerebrum to that of the antennæ, and the tritocerebrum to that of Tömösvary's organ.

Structure of Ocelli in Periplaneta and Cloeon.*—W. v. Reitzenstein finds that in both these forms the ocellus ("fenestra") is a three-layered eye which arises through invagination of the hypodermis, and from the middle layer of which the inverse retina is differentiated. The development in *Vespa* is similar.

Inheritance of Acquired Characters in Insecta.†—E. B. Poulton discusses the evidence derived from the study of various phenomena from the Insecta bearing upon this problem. Some of the points dealt with are the origin of the pupal groove which receives the silken loop in Pierinæ, the effect of gravity upon the shape of suspended pupæ such as those of the Nymphalinæ, various protective resemblances, and instincts in Insects. The conclusion drawn from the whole is that nowhere in the Insecta is there support for the assumption upon which the Lamarckian theory is founded, that acquired characters are transmissible.

Development of Head Skeleton in Blatta.‡—W. A. Riley has investigated the relations of the sclerites of the adult *Blatta* to the primitive segments. He concludes that sclerites originate from mechanical causes, and do not necessarily have any relation to the primary segmentation. Their value as an index to relationship among insects is not, however, depreciated. They are to a marked degree constant, and may be homologised in the different groups.

Digestion in Cockroach.§—Dimitri Neniukoff has studied the digestive processes in *Periplaneta orientalis* from the chemical side. The salivary secretion, always neutral in reaction, changes starch into glucose, has a slight peptonising function, and contains Rhodankalium (KCNS). The crop-extract changes starch into glucose and has a very slight peptonising power. The mid-gut has normally an alkaline reaction and an energetic proteolytic ferment.

Palæozoic Cockroaches.‖—E. H. Sellards has studied the structure of palæozoic cockroaches and describes a number of new forms. Cockroaches represent a remarkably persistent type. They range from the Carboniferous, and doubtless took their origin somewhat earlier. The group has by no means remained stationary throughout its long existence, but illustrates the laws of advance and specialisation.

The author shows how the cockroaches afford illustration of (*a*) *specialisation by reduction*, e.g. in the shortening of the ovipositor and in the more or less complete fusion of two or more of the main veins at their base or throughout a part of their course; (*b*) *parallel evolution*, e.g.

* Zool. Jahrb., xxi. (1904) pp. 161–80 (2 pls.).
† Trans. Entomol. Soc. (London, 1904) part v., pp. civ.–cxxxi.
‡ Amer. Nat., xxxviii. (1904) pp. 777–810.
§ Physiologiste Russe, iii. (1904) pp. 31–4.
‖ Amer. Journ. Sci., xviii. (1904) pp. 213–27 (37 figs., 1 pl.).

in the independent origin of the plaiting of the hind wings in more than one division of the Orthoptera; (*c*) *mechanical factors*, e.g. in the plications which are doubtless developed largely in response to mechanical need and in the cross veins; and (*d*) *recapitulation of ancestral characters in ontogeny*, e.g. in the nervation of the wing.

Oenogyna baeticum.*—F. Silvestri gives an account of this moth belonging to the family Arctiidæ, whose polyphagous larvæ do damage in Italy and elsewhere to leguminons and many other kinds of plants. It has its headquarters in Spain, Morocco, Algeria and Tunisia. There is a striking sexual dimorphism, notably illustrated by the minute scale-like wings of the female in contrast to the normal wings of the male. The life-history, the natural checks, and preventive remedies are duly discussed.

Stalked Eggs of Rhyosa persuasoria.†—E. Bugnion gives an account of the ovaries and oogenesis in this very large Ichneumonid which lays its eggs in various wood-boring larvæ, e.g. of *Sirex gigas* and similar forms. One interesting feature is the long stalk of the egg—a cylindrical filiform pedicel which occupies 9–10 mm. of the total length (12–13·5 mm.) of the egg. The development of the stalk is described.

Ants' Nest Beetles.‡—Arthur M. Lea reports on a collection of fourteen beetles from ants' nests, made by J. C. Goudie in the Mallee district of North-west Victoria. He notes that a large proportion of the species have less than the usual number (11) of joints to the antennæ. The next most noticeable feature is the frequency with which the prothorax is deeply and often very peculiarly sculptured; and another peculiarity is the method (usually by ridges or grooves) by which the appendages are protected. In many of the species, moreover, the buccal appendages are often very small, and in some of them quite invisible. Some forms seem to be welcomed by the ants; others are distinctly hostile.

Sound Production in Lamellicorn Beetles.§—G. J. Arrow reviews and describes the various stridulating organs existing in this group, giving also a systematic description of the species referred to in the paper. The most noticeable feature with regard to these organs is the great variety of situation they affect in the adult. On the other hand, in the larvæ they fall into three series, viz. the Lucanid group in which the stridulating plate is on the hind trochanter, the Geotropid group, in which it is on the middle coxa, and the Scarabæid group, where the jaw bears the vocal organs. These larval organs are considered of some significance in determining relationships, and several points in the classification of the group are considered from this standpoint.

Structure of Female Flea.‖—M. Lass has made a minute study of the structure of the female flea (*Pulex canis* or *serraticeps*). Some of

* Bull. Scuola Agric. Portici, ser. ii., No. 10 (1905) pp. 1–12 (7 figs.).
† Bull. Soc. Vaudoise Sci. Nat., xl. (1904) pp. 245–9 (1 pl.).
‡ Proc. R. Soc. Victoria, xvii. (1905), pp. 371–85 (1 pl.).
§ Trans. Entom. Soc. London (1904) pp. 709–50 (1 pl.).
‖ Zeitschr. wiss. Zool., lxxix. (1905) pp. 73–131 (2 pls.).

his results are the following:—Larva, pupa, and imago have ten abdominal segments; the sex is recognisable in the half-grown larva; each larval segment has two rows of setæ, except the last, which has one; the absence of eyes in the larvæ is confirmed; the larva has eight ganglia, the female pupa has seven; the absence of a hypopharynx is confirmed; there is a nervous connection between the last abdominal ganglion and the "sensory plate"; in the imago there are nerve-cells beneath the sensory plate; in the ninth and tenth segments there is a tergite and sternite; the last (tenth) stigma lies on the tergite of the eighth abdominal segment; there is a glandular organ to the anal side of the bursa copulatrix; the ovarioles are "panoistic," i.e. without special nutritive-cells; the terminal thread and terminal chamber are continuous; the indifferent cells of the terminal chamber give rise to ova, follicle-cells, and the elements of the membrana propria; the follicles are quite separated from one another by the membrana propria; the ovum shows at the two flattened poles the primordia of micropyle canals.

The Pulicidæ have few relations with Diptera; they form a special order between Diptera and Coleoptera.

New Flightless Fly.*—Günther Enderlein describes *Thripomorpha paludicola* g. et sp. n., one specimen of which he obtained near Berlin when collecting *Thrips* (Thysanoptera). As its name suggests, this new flightless fly has an extraordinarily close likeness to *Thrips*. The shape of the body seen from above and the size and movements of the animal recall a large Thysanopteron. It is however, one of the Bibionidæ, with a quite wingless thorax.

Mosquitoes of Pará.†—Emilio A. Goeldi gives an account of his investigations on the mosquitoes of Pará, with especial reference to the species *Stegomyia fasciata* and *Culex fatigans* and their hygienic importance. He has also many interesting communications to make on their mode of life, their food, and their reproduction.

Social Wasps of Pará.‡—A. Ducke gives a synoptic table of the South American genera of Vespidæ, and a particular account of the social wasps of Pará, with ethological notes.

δ. Arachnida.

Auditory and Olfactory Sense of Spiders.§—Annie H. Pritchett has experimented with the two species, *Geolycosa texana* Montg., and *Pardosa mercurialis* Montg., with the following results. No responses were obtained to tuning-forks of various vibrations, nor to the crashing sound of metal plates struck with a bar. From this she concludes that these spiders probably do not hear at all. All parts of the body are extremely sensitive to touch, and the spider responds immediately if it or the cage comes in contact with the tuning-fork. Experiments with individuals variously mutilated yielded the conclusion that the ability to

* Zool. Jahrb., xxi. (1905) pp. 447–50 (1 pl. and 4 figs.).
† Boll. Mus. Goeldi, ix. (1904) pp. 129–97.
‡ Tom. cit., pp. 317–74 (2 pls. and 4 figs.).
§ Amer. Nat., xxxviii. (1904) pp. 859–67.

perceive odours is distributed over the whole integument of the spider, and that there is no definitely localised olfactory organ.

Eggs of Tardigrada.*—F. Richters summarises the known facts regarding the eggs of Tardigrada. They are laid either free or within a membrane. Nothing is known of the marine genera *Echiniscoides* and *Lydella*. All eggs laid in membranes have a smooth shell; those free have very differently formed apparatus for fixation, whose function is to prevent the eggs being washed out by the rain from the mossy turf in which they develop. The membrane enclosing the smooth eggs bears numerous claws which effect the same purpose. In a second paper † a description of a new species, *Echiniscus conifer*, is given.

Marine Pseudoscorpion from the Isle of Man.‡—A. D. Imms reports the occurrence of *Obisium maritimum* Leach among the rocks between the limits of high and low tides at Port Erin. It was found in the recesses of the rock fissures along with adults of the marine Collembolon *Anurida maritima*, larvæ, pupæ, and imagines of the Coleopteron *Micralymna brevipenne*, and a species of *Acarus*. It is probable that the pseudo-scorpion preys upon the Collembola, and most likely upon the *Acari* also. When alarmed or irritated, it ran about actively in both a forward and backward direction with outstretched pedipalps, but it was not seen to run sideways, as some pseudoscorpions do.

When submerged, twice every twenty-four hours, it probably relies upon the store of air within its tracheal system. In the living condition this species is easily recognised by the olive-greenish colour of the body, contrasted with the bright red-brown of the pedipalps. Pickard Cambridge has obtained the same form from the Devonshire coast and from Jersey; it does not appear to be known on the Continent. This is the second recorded occurrence in the British Isles since the time of Leach.

Pentanymphon Antarcticum.§—T. V. Hodgson describes this new type found by the 'Discovery,' and also by the 'Scotia.' The body is smooth, very slender, with lateral processes widely separated; there are *five pairs* of ambulatory appendages; the mandibles are well-developed, 2-jointed, and chelate; the palps are 5-jointed; the ovigerous legs are 10-jointed, terminating in a claw, the last four joints with a single row of denticulate spines. The only feature of importance which separates it from the genus *Nymphon* is the presence of a fifth pair of legs.

Ten-legged Pycnogonids.‖—Leon J. Cole calls attention to the description which Eights ¶ gave in 1837 of a Pycnogonid (*Decolopoda australis*) with a fifth pair of walking legs from the South Shetland Islands. C. V. Hodgson has found several specimens in the 'Scotia' collection from the South Orkneys, along with a single specimen of *Pentanymphon antarcticum* which he described from the 'Discovery' collection. In *Decolopoda*, as Cole points out, we have the most primi-

* Ber. Senck. Nat. Ges. (1904) pp. 59–70 (2 pls.).
† Tom. cit., pp. 73–4.
‡ Ann. Nat. Hist., xv., (1905) pp. 231–2.
§ Op. cit., xiv. (1904) pp. 458–62 (1 pl. and 1 fig.).
‖ Op. cit., xv. (1905) pp. 405–15.
¶ Boston Journ. Nat. Hist., i. (1837) pp. 203–6 (1 pl.).

tive of the known Pycnogonids. The chelifori are well developed and strongly chelate, the palpi are present and made up of ten joints, the ovigera are present in both sexes, and are provided with denticulate spines, and the trunk-segmentation is distinct. Cole puts the relationships of the Pycnogonids in the following scheme :—

PYCNOGONOMORPHA
Pycnogonidæ
Phoxichilidæ
Phoxichilidiidæ
Hannonia
Pallenidæ
Nymphonidæ
Pentanymphon

COLOSSENDEOMORPHA
Pasithoidæ
Ammotheidæ
Eurycydidæ

Decolopoda

Decolopoda of Eights.*—J. C. C. Loman calls attention to the description and figures of *Decolopoda australis*, which were given about seventy years ago by James Eights. Loman says that the description and figures indicate a Pycnogonid *larva*, probably referable to Hoek's *Colossendeis robusta*. The larvæ of *Colossendeis* have cheliferæ with a two-jointed shaft at an age when the palps and legs have their final form. Only in one respect does *Decolopoda* differ from all other Pycnogonids—in having ten legs instead of eight, and Loman thinks that Eights must have miscounted them ! "Without this supernumerary pair of legs the animal is a typical *Colossendeis* larva ; with the ten legs it is an irrational monstrosity ('*ein irrationelles Monstrum*')." As will be seen from the report preceding this, the "monstrosity" is a reality, and there is no reason for supposing that Eights would count eight as ten.

Myrmecophilous Acari.†—A. Berlese gives a fully illustrated account of the numerous myrmecophilous Acari belonging to the group Mesostigmata, including the families Uropodidæ, Antennophoridæ, Lælaptidæ, and Gamasidæ. He deals with about 60 species, many of which are new.

ε. Crustacea.

Commensal Crab on a Sea-Urchin.‡—E. L. Bouvier and G. Seurat describe *Eumedon convictor*, sp. n., closely allied to *E. pentagonus*, described by A. Milne-Edwards. It was found living as an intimate commensal on a long-spined sea-urchin, probably *Echinothrix turcorum*, from the archipelago of Gambier. Commensalism is rare in crabs of the group Parthenopiæ, the only other case being that of *Zebrida*

* Zool. Anzeig., xxviii. (1905) pp. 722-3.
† Redia, i. (1904) pp. 299-474 (14 pls.).
‡ Comptes Rendus, cxl. (1905) pp. 629-31.

which simply lives among the spines of a sea-urchin, whereas this new form is imbedded in the anal region in a capacious invaginated pocket. Only the female was found; the male is probably free-living. In spite of its close commensalism, almost like endo-parasitism, the crab has a hard, well-calcified shell. It has a dull violet colour, less pronounced than that of the sea-urchin.

Variations in Number and Arrangement of Male Genital Apertures in Nephrops norvegicus.*—D. C. McIntosh finds that the male genital openings may occur singly on the right or the left second walking leg, on both the third walking legs, or singly on either the right or the left, or only on the right fourth walking leg, or normally on both sides. F. H. A. Marshall found the percentage of abnormal specimens from the Firth of Forth 12·2; McIntosh specimens from the Clyde had a percentage of abnormality 2·49.

Proportions of the Sexes in Nephrops norvegicus.†—D. C. McIntosh finds that in the Clyde area the proportions of the sexes are approximately equal; that the size of fully grown males is considerably greater than that of fully grown females; and that the animals occur together in companies of approximately the same size.

Scales of Pandalidæ.‡—H. Coutiere finds that Decapods of the family Pandalidæ have a remarkable peculiarity, namely a covering of smooth, transparent, lanceolate scales ("*phanères*"), each with a short stalk traversed by a central canal. They overlap one another, are readily knocked off, and recall the scales of Lepidoptera. A dozen species were examined, and all exhibited this peculiar cuticular covering.

Luminosity of Gnathophausia.§—G. Illig discusses the phosphorescence of a Gnathophausia, obtained by the German Deep Sea Expedition from a depth of 1326 metres. The colour was greenish, and was due to a secretion which exuded from two glands below the cephalothorax anteriorly, at the base of the second maxillæ. G. O. Sars described the structure in *Gnathophausia calcarata*, and suggested that it was luminous. The secretion is formed in two glandular sacs, which lead into a large reservoir with a duct opening on a papilla at the base of the exopodite.

Phagocytary Organ of Decapods.‖—L. Cuenot has investigated this in a large number of species. There are two distinct lymphoid structures—a globuligenous organ, forming the amœbocytes of the blood, and a phagocytary organ. The former is always situated near the ophthalmic artery; it completely invests it in some, e.g. *Pagurus*, it is spread out upon the stomach in others, e.g. *Astacus*, in others, e.g. *Palæmon*, it forms a definite mass at the base of the rostrum. The phagocytary organ, except in *Nika edulis*, is connected with the hepatic arteries. In Decapods with a cephalothoracic liver, the phagocytes envelop the hepatic arterioles; in the Pagurids, which have an abdominal liver, they cover the numerous

* Proc. Cambridge Phil. Soc., xii. (1904) pp. 441–4.
† Loc. cit. ‡ Comptes Rendus, cxl. (1905) pp. 674–6.
§ Zool. Anzeig., xxviii. (1905) pp. 662 (2 figs.).
‖ Arch. Zool. Exp., iii. (1905) pp. 1–15 (1 pl.).

cæca branched over the arteries. In the Palæmonidæ, besides the hepatic phagocytes, there are in the heart vacuolar cells which, in a feeble degree, have a phagocytary function. The vacuolar liquid has an acid reaction.

Minute Structure of Heart in Decapoda.*—W. Gadzikiewicz has studied this in *Palæmon*, *Pachygrapsus*, and *Astacus*. The heart consists of two layers—an internal muscularis and an external adventitia (visceral pericardium or epicardium). The adventitia consists of vesicular cells in many rows, suggesting many-layered epithelium. The myocardium consists of individual fibres whose protoplasmic substance coalesces to form a general protoplasmic matrix in which the contractile fibrils lie. Many blood corpuscles merge in the protoplasmic substance of the muscle-fibres, and are disintegrated. There is no "cardiac endothelium" nor "intima." The author's conclusions support the hæmocœl theory of Lang.

Life-History of Gnathia maxillaris.†—Geoffrey Smith has studied the metamorphosis and life-history of this Gnathiid or Anceid, whose larval form, known as *Praniza*, lives ecto-parasitically on various kinds of fishes. He discusses the final metamorphosis of the *Praniza* into the male and female adult, and the striking variation in the size of the adults. The adult males vary in size from 1–8 mm., and the much rarer adult females from 1–7 mm. The bimodality of the curve of size is due to the existence of two critical periods for the final transformation, and the presumption is strong that the size to which any larva may attain is chiefly due to the conditions of nutrition it meets with, and its fortune in being brushed off its host at an early or late stage of growth. The larger adults owe their size to the length of time spent and the amount of nutrition acquired during the *Praniza* stage. On the whole the small males have mandibles that are broader and shorter than those of the large males: in other words, there is an incipient structural dimorphism in the mandibles, in correlation with the difference in size of the males.

The life-history may be thus tabulated:—

Normal segmented larvæ
0·8–1·2 mm.

Pranizæ on fish
1–4 mm.

Small adults on ground

Giant segmented
larvæ on ground
4–5 mm. ⟶ Pranizæ
on fish
5–8 mm.

Large adults on ground

Notes on Alcippe lampas.‡—K. W. Genthe gives some notes which are supplementary to the work of Berndt and earlier writers upon

* Bull. Internat. Med. Sci. Cracovie, 1904, pp. 424–34 (7 figs.).
† MT. Zool. Stat. Neapel, xvi. (1904) pp. 469–71 (1 pl.).
‡ Zool. Jahrb., xxi. (1904) pp. 181–200 (2 pls.).

this Cirripede. The points taken up are mainly anatomical, e.g. the muscle systems, the digestive apparatus, and the circulation, though some facts regarding its habits are also given. At Wood's Hole it is found in large numbers, boring in Gastropod shells inhabited by hermit crabs, of which it appears to be a regular messmate.

Chilian Cirripeds.*—A. Gruvel describes the structure of some interesting operculate Cirripedia brought by L. Plate from Chili, namely *Coronula diadema*, *Balanus psittacus*, *B. flosculus* var. *sordidus*, *Chthamalus cirratus*, and *C. scabrosus*.

Annulata.

Mosaic Development in the Annelid Egg.†—E. B. Wilson records certain interesting facts in the development of *Lanice*, having an important bearing on this theory. When either cell of the two-celled stage is destroyed, the remaining cell segments as if it still formed a part of an entire embryo. The later development, however, is essentially different. The posterior cell develops into a segmented larva with a prototroch, an asymmetrical pre-trochal or head region, and a nearly typical metameric seta-bearing trunk region, the active movements of which show that the muscles are normally developed. The pre-trochal or head region bears an apical organ, is more or less asymmetrical and with only one eye. The anterior cell likewise yields a prototroch and a pretrochal region, with an apical organ, but produces no post-trochal region, develops no trunk or setæ, and does not become metameric. This result shows that from the beginning of development the material for the trunk region is mainly localised in the posterior cell; and furthermore, that this material is essential for the development of the metameric structure. The opinion is expressed that, so far as the early stages of development are concerned, it is difficult to escape the hypothesis of formative stuffs or specific morphoplasmic substances, in some form. The problem of the localising or form-determining factors which are responsible for the determination of the segregation pattern remains, however, unsolved.

Ventral Sensory Organs of Palolo Worm.‡—Olav Schröder describes the peculiar structures which lie along the ventral median line of *Eunice viridis* like so many pigment spots. There is a lens-like thickening of the cuticle, there is pigment, there are sensory cells and intermediate cells (*Zwischenzellen*), but there is little to warrant the view of Spengel, Hesse, and others, who regarded the organs as "eyes." The author notes how his results differ from those of Hesse, who regarded Schröder's sensory cells as primitive nerve fibrils and Schröder's intermediate cells as nerve-cells.

Polynoid Commensal of Balanoglossus.§—Ch. Gravier describes *Lepidasthenia digueti*, sp. n., which lives as a commensal in the dorsal

* Zool. Jahrb., Supplementband vi., Fauna Chilensis, 1904, pp. 307–52 (3 pls.).
† Science, xx. (1904) pp. 748–50.
‡ Zeitschr. wiss. Zool., lxxix. (1905) pp. 132–49 (2 pls. and 2 figs.).
§ Comptes Rendus, cxl. (1905) pp. 875–8.

tube formed by the "genital wings" of a very large species of *Balanoglossus* from the Gulf of California. One of the Polynoids bore fixed to its back a remarkable Stomatopod, also new, belonging to the genus *Lysiosquilla;* its dorsal surface has a marked mimetic resemblance to the back of the Polynoid. In 1882 Giard reported the occurrence of another Polychæt, *Anoplonereis* (*Ophiodionnus*) *herrmanni*, as a commensal on two species of *Balanoglossus*.

Anatomy and Histology of Blood Vessels in Lumbricus.*—O. Gungl has investigated this subject. A typical vessel possesses a homogeneous connective tissue membrane, sharply defined and deeply stained by rubin and acid-fuchsin. Towards the lumen are elongated cells which never form an epithelial-like lining. On the outer side the wall cells lie upon the intima, and from these arise the striped muscle fibres which are arranged within the connective tissue in a doubly oblique manner. If the vessel is free in the body cavity, e.g. ventral vessel, it possesses a peritoneal layer. The small vessels and capillaries are derivable by loss of musculature from a vessel of the ventral type. The author further works out a comparison between these and the capillaries of Vertebrates.

Variation and Correlation in the Earthworm.†—Raymond Pearl and W. N. Fuller have made statistical studies of *Lumbricus agricola* from which they conclude that there is a great range of variation in the total number of somites (79–164) and a rather high variability as measured by the standard deviation and the co-efficient of variation. This earthworm is markedly more variable in length than in the number of somites. The clitellum is decidedly more variable with respect to the number of its somites than is the body in front of the clitellum. As the number of somites in front of the clitellum increases, there is a strongly marked tendency for the number of clitellar somites to decrease. With regard to negative correlation, the suggestion is made that it may have ultimately the same physiological basis as compensatory regulation. The foregoing are the main points in the abstract; the complete paper has has not yet appeared.

Gephyrea of Japan.‡—Iwaji Ikeda gives an account of 37 species—26 Sipunculoids under 7 genera and 11 Echiuroids under 3 genera. Previous to this paper only four Gephyreans seem to have been recorded from Japan. Of the 37 species described, 24 are new. A useful diagnostic key is given.

Ovogenesis of Sagitta.§—N. M. Stevens supplies the following additional facts regarding the ovogenesis in *Sagitta*, determined on material of *S. elegans*. The so-called sperm-oviduct of *Sagitta* is merely a sperm-duct. A temporary oviduct is formed periodically between the sperm-duct and the germinal epithelium. This duct appears to be opened up by the activity of the individual eggs pushing their way out of the ovary proper and in between the germinal epithelium

* Arbeit. Zool. Inst. Wien, xv. (1904) pp. 155–82 (1 pl.).
† Fifth Report Michigan Acad. Sci., 1903, pp. 200–2.
‡ Journ. Coll. Sci., Tokyo, xx., Art. 4 (1904) pp. 1–87 (4 pls.).
§ Zool. Jahrb., xxi. (1904) pp. 243–52 (1 pl.).

and the sperm duct. The chromosomes preserve their individuality from the time when reduction in number occurs in the very young oocytes to their appearance as tetrads in the first polar spindle. The scattered chromosomes of the germinal vesicle are collected by currents in the karyoplasm, at the point where the first polar spindle is formed. There is a preliminary longitudinal splitting of the chromosomes during their reduction in size. The chromosomes in the young oocytes conjugate longitudinally, instead of end to end as in the spermatocytes; there are two types of conjugation of the chromosomes—oocyte and spermatocyte, and two corresponding types of maturation divisions, giving, however, equivalent results. The chromatin (?) granules which result from the reduction in size of the chromosomes pass directly out from the nucleus into the cytoplasm along strands of karyoplasm.

Nematohelminthes.

Freshwater Nematodes of New Zealand.*—N. A. Cobb describes four new free-living species—*Mermis Novæ Zealandiæ*, *Mononchus rex*, *Dorylaimus Novæ Zealandiæ*, and *D. profundis*. These belong to well-known genera, and present no remarkable variations from the types of their respective groups. It is probable that many of the free-living genera have a very wide geographical distribution. The small size of the individuals, their fecundity, their adaptability to transportation by a great variety of agencies, and their resistance to desiccation, at least in certain stages, are all in favour of wide distribution. A noteworthy point is the depth from which some of the specimens were captured; thus the two species of *Dorylaimus* were obtained from 200–1100 feet.

New Free-living Nematode from Patagonia.†—J. G. de Man describes a new form, *Plectris* (*Plectroïdes*) *patagonicus*, which differs from *P. antarcticus* in form, in structure of head lips, and of œsophageal bulb. The type specimen was found in a dung-ball of *Grypotherium darwini*.

Ichthyonema grayi.‡—James F. Gemmill gives an account of *Ichthyonema grayi* Gemmill and von Linstow, an interesting Nematode of large size found in the perivisceral cavity of the common sea-urchin in different localities in the Firth of Clyde. Not more than four females (600–1500 mm. in length by 2–4 mm. in breadth) occurred in any one sea-urchin, and in one case only a single large specimen was present, which measured quite five feet in length. Besides the large specimens, some smaller ones were always present, 50–200 mm. in length, which seem to be the males. A full description has been published elsewhere §, and we may simply refer to some notable features:—the absence of mouth, anus, and excretory canals; the poorly developed muscular system; the simplicity of the nervous system, represented by a thickening of the hypodermis at the head end, which is not continued backwards into definite longitudinal cords, except, perhaps, for a short

* Proc. Cambridge Phil. Soc., xii. (1904) pp. 363–74 (4 figs.).
† Ber. Senck. Natur. Ges. (1904) pp. 41–5.
‡ Trans. Nat. Hist. Soc. Glasgow, vi. (Dec. 1903) pp. 299–301.
§ Arch. Natur., 1902.

distance on the ventral aspect; the single ventral ovary, almost as long as the worm itself. The ova all ripen at the same time; the early development takes place within the body, which eventually becomes little more than an elongated sac filled with eggs or embryos. The largest specimen contained upwards of 20 million embryos.

We may add to this report that a specimen of this interesting parasite was recently obtained from a sea-urchin brought in by an Aberdeen trawler.

Platyhelminthes.

Sexual Phases in Geonemertes.*—W. R. Coe finds that the Bermuda land Nemertean, *Geonemertes agricola*, is not only hermaphrodite but also viviparous. The sexual phases are further complicated by the appearance of undifferentiated gonads which form both kinds of sexual products. Such gonads often occur interspersed among others which form either ova or spermatozoa only. As a rule in such an ovo-testis the spermatozoa are discharged before the single ovum of the same organ has matured. Self-fertilisation probably does not normally occur.

Land Planarian from Ohio.†—L. B. Walton records the occurrence of a species of *Rhynchodemus* in Ohio. It differs in many particulars from the only known form of this genus occurring in the United States, although it is probably related to it.

Two Interesting Trematodes.‡—Norman Maclaren gives a full description of (*a*) *Diplectanum æquans* Diesing, a Gyrodactylid from the gills of *Labrax lupus*, etc., which he refers to the genus *Tetraonchus* Diesing, sub-genus *Diplectanum*, and (*b*) *Nematobothrium molæ*. sp. n. from the sunfish, which he refers to the Distomidæ.

Habits and Structure of Cotylaspis insignis.§—H. L. Osborn has investigated a number of points in the anatomy and habits of this Trematode. In Lake Chautauqua it is confined to *Anodonta*, although this is not the case with respect to the United States generally. It most commonly occurs adhering very firmly by its huge ventral sucker to the cloacal surface of the kidney of its host. It can hardly be considered even ecto-parasitic, but is more strictly commensal, since it not only does not draw any nutriment from its host, but is even beneficial by keeping the surface of the kidney free from organic material. The almost free habit would seem to be secondary, and arrived at by way of a partially free ancestral form, having habits like those of *Aspidogaster*. The excretory system is unlike that of any other known member of the family. It has a single terminal dorsal pore, two independent rhythmically pulsatile bladders, a collecting vessel running directly to the level of the pharynx, a recurrent vessel, ciliated, directly continuous with the collecting vessel, two branches from this—one anterior and one posterior—into which all the larger capillary vessels discharge, minute non-ciliated capillaries terminated by ciliated flame-

* Zool. Anzeig., xxviii. (1905) pp. 454–8.
† Ohio Naturalist, v. (1903) No. 3, p. 254.
‡ Jenaische Zeitschr. Naturwiss., xxxviii. (1904) pp. 572–618 (3 pls. and 6 figs.).
§ Zool. Jahrb., xxi. (1904) pp. 201–35 (3 pls.).

cells. There is a single testis; the oviduct resembles that of *Aspidogaster* near the ovary in having the same "tuba fallopii;" there is no distinct ootype or shell gland, and no Laurer canal.

Incertæ Sedis.

Excretory Apparatus in Entoprocta.*—G. Stiasny has observed various details of this in the living specimens of *Pedicellina echinata* and *Loxosoma annelidicola*, as well as sections of these and other types. In *P. echinata* the excretory apparatus consists of an unpaired duct which divides into two branches, forming an inverted Y. It lies between the œsophagus and nerve ganglion. The blind ends of the fork are closed by an end cell, which appears like a massing of plasma with a large nucleus. The wall of this canal contains two or more cells with large nuclei; the lumen is wide, the cells are very long and narrow and without cilia, except the end cell, which has a very large "flame." There are cilia on the unpaired portion of the system. It is probable that, contrary to the finding of Prouho, the excretory apparatus of the Entoprocta is of one type.

Rotifera.

New Rotifers from Scotland.†—James Murray, in studying the fauna of Scotch lakes in connection with the Lake Survey under the Pullar Trust, has found the following twelve new species of Rotifers of the order Bdelloida, which he describes very fully, with seven plates of illustrations: *Callidina angusticollis*, *C. annulata*, *C. crenata*, *C. pulchra*, *C. muricata*, *C. crucicornis*, *C. armata*, *C. incrassata*, *Philodina laticornis*, *Ph. laticeps*, *Ph. humerosa*, and *Microdina paradoxa*. The last-named forms a new genus and a new family, Microdinadæ, characterised by the absence of a corona, and by jaws intermediate between the ramate type of all other Bdelloida, and the malleo-ramate type of *Melicerta*.

Echinoderma.

Artificial Production of Vitelline Membrane in Unfertilised Ova of Sea Urchin.‡—Curt Herbst finds that traces of silver salts in the water evoke the formation of vitelline membranes on unfertilised ova, as also happens under the influence of chloroform, clove-oil, xylol, and other reagents. The formation and elevation of the vitelline membrane is not a simple coagulation process. The elevation of the membrane from the surface of the egg is first of all due to a vital change in the cytoplasm, which retracts from the primary vitelline membrane and secretes a substance between that and itself. When water enters the interspace the primary limiting membrane is raised mechanically. Apart from this, however, there is the modification of the readily penetrable primary membrane into a more resistent secondary envelope. This change may be a coagulation or similar process. In any case it can be induced in unfertilised ova by coagulating reagents which do not rapidly kill them. It follows that in normal conditions, the spermatozoon must contain a

* Arbeit. Zool. Inst. Wien, xv. (1904) pp. 183–96 (1 pl.).
† Trans. Roy. Soc. Edin., xli. (1905) pp. 367–86 (7 pls.).
‡ MT. Zool. Stat. Neapel, xvi. (1904) pp. 445–57.

coagulating substance which induces in the ovum the elevation of the vitelline membrane.

New Devonian Ophiurid.*—F. A. Bather describes *Sympterura minveri* g. et sp. n., a Devonian Ophiurid from Cornwall. The genus is thus diagnosed :—A Lapworthurid with spinulose disc extending to second arm-segment, with oral skeleton of teeth, long jaws, and short mouth-frames (torus not seen), with free arm-segments containing a vertebral ossicle, possibly compound, grooved ventrally and provided on each side with two wings, to the distal of which is attached an adambulacral spiniferous element. The structure of the arm-segments suggests that the vertebræ may be composed of two successive pairs of ambulacral elements, and reasons are given for suspecting that this may be the case in all the more advanced Ophiurids. The holotype of the species, which is the first Echinoderm described from these Cornish slates, is in the British Museum.

Cœlentera.

Movements and Reactions of Hydra.†—G. Wagner has made a careful study of the behaviour of *Hydra viridis* and other species. An undisturbed *Hydra* contracts at fairly regular intervals ; after contraction it expands in such a way as to occupy a different position from that previously occupied. It has only one form of response to a single mechanical stimulation, localised or non-localised ; this response is by contraction, more or less complete, and not necessarily toward or away from the stimulus. When a stimulus is repeated as soon as the polyp has regained the expanded stage, contraction results as before. If a non-localised mechanical stimulus is repeated at very brief intervals, say one second, acclimatisation is soon effected, and the *Hydra* no longer responds. A localised stimulus applied at such brief intervals brings about at first an apparent acclimatisation. This is soon followed in many cases by the complicated "escape" movement, the *Hydra* moving away from the region where stimulation occurs. This shows that the physiological condition of the animal has been changed, so that to the same stimulus under the same external conditions it now gives a reaction different from that given at first.

Hydra shows no orientation movements in response to stimulation by a current of water. When the foot is detached the animal performs active movements directed toward restoring the normal condition of attachment. Geotaxis plays no part. Non-localised chemical stimuli cause general contraction, except in certain food reactions. A strong localised chemical stimulus causes a bending of the body or tentacles, as the case may be, toward the side stimulated. The result is due to the contraction of the ectoderm cells directly affected by the reagent, and is non-adaptive. *Hydra* reacts to food only after a period of hunger. A mechanical stimulus will not produce a discharge of nematocysts ; a chemical stimulus does, probably by direct effect, in the area touched by the reagent. The nematocysts can and do pierce the epidermis of the prey, but *Hydra* seems able to paralyse prey without discharging nematocysts.

* Geol. Mag., ii. (1905) pp. 161–9 (1 pl.).
† Quart. Journ. Micr. Sci., xlviii. (1905) pp. 585–622 (6 figs.)

Biological Studies on Corymorpha.*—H. B. Torrey describes *Corymorpha palma*—both adult and young forms—and discusses its activities in movement, feeding, and the like.

It is unusually active for a hydroid. It is everywhere sensitive to mechanical stimuli, irritant chemicals and abrupt changes in temperature, nowhere to odorous substances.

The prehensile mechanism is composed of proximal tentacles which move toward the mouth in response to all effective stimuli; distal tentacles which move away from the mouth in their initial response to stimuli; and a proboscis, which may move toward the point stimulated. These movements, as well as shortening and possibly lengthening the stem, are performed by muscles.

The stem of the adult responds to the stimulus of gravity by means of a change in the turgidity of the vacuolated axial cells. The response of these cells varies according as the stem is attached proximally or distally, and according as it is heteromorphic or not. The polarity of the stem is expressed not only by the regenerative development, but by changes in the axial cells.

Locomotion is accomplished by amœboid cells located at the proximal end in the adult, more generally distributed in the larva, and covering the club-shaped ends of the filaments of the hold-fast.

Cilia are present on the epithelial cells lining the hydranth cavity and the peripheral canals. Supplemented by contractions and expansions of the hydranth cavity, they provide for the circulatory currents through the body.

Eggs are laid both in summer and winter, usually during the morning hours. They have adhesive coats. The planulae are never ciliated, and their locomotion is limited to very slow creeping movements. The larvæ are geotropic.

Gymnoblastic Hydroids of Western Mediterranean.†—S. Motz-Kossowska gives an account of gymnoblastic hydroids collected near Banyuls and neighbouring coast and Balearic Islands. Seven new species and two new varieties are recorded. A marked resemblance to the fauna of the bay of Naples was noted. The paper includes a discussion of the phylogenetic position of the several members of the group. The author agrees with Schneider in placing the Corynidæ at the base of the system, and from a typical Corynid with capitate tentacles recognises a departure along three distinct lines, viz. (*a*) diminution of the number of tentacles, e.g., *Tiarella singularis*; (*b*) diminution of number of tentacles and atrophy of the capitula of the proximal whorl, e.g., *Cladonema*: *Coryne pintheri* and *Stauridium productum* being intermediate; (*c*) great development of proximal circle of filiform tentacles as *Tubularia* with *Pennaria* intermediate. It is possible that those Corynids with stinging buds on the external face of the tentacles (*Tiarella*) may have given rise to forms with ramified tentacles like *Cladocoryne*.

Notes on Hydromedusæ from Naples.‡—Chas. W. Hargitt has studied several species, some of which are believed to be new, others

* Journ. Exper. Zool., i. (1904) pp. 395–422.
† Arch. Zool. Exp., iii. (1905) pp. 39–98 (1 pl.).
‡ MT. Zool. Stat. Neapel, xvi. (1904) pp. 553–85 (2 pls.).

more or less rare, and all of more than ordinary biological interest. He describes *Pachycordyle weismanni*, sp. n., and notes, *inter alia*, that in the females (which alone were found) the germ-cells originate in the endoderm and do not occur elsewhere at any time during their growth or maturation. The medusoid is either extremely degenerate, or one of very primitive type. Its development within a chitinous capsule (gonangium ?) associated with the sporosac-like history of the gonophore, would seem to suggest the latter alternative. The development of Anthomedusæ within gonangia is quite rare, if not wholly anomalous.

The oogenesis, maturation, and fertilisation in *Tubularia mesembryanthemum* Allm. are then described. The germ-cells were found both in the ectoderm of the peduncle of the gonophore, as Brauer contends, and in the ectoderm and endoderm of the spadix, as Ciamician and Weismann reported. An account of the cleavage, the germ-layers, and the embryo is given.

The author also describes *Perigonimus napolitanus*, sp. n. (?), *Gemmaria implexa* Alder, *Corydendrium parasiticum* Cavolini, and *Podocoryne conchicola* (Philippi), and supplies numerous contributions towards a clearer knowledge of some disputed problems concerning the Hydromedusæ.

Regeneration and Non-Sexual Reproduction in Sagartia.*—R. B. Torrey and J. R. Mery describe the different modes of fission observed in *S. davisi*. They endeavoured experimentally to discover the cause of fission. A complete answer has not been found, though they conclude that an interruption of the physical continuity of two portions of a polyp by a cut in the normal fission plane tends to interfere with the physiological inter-action of the separated regions, and to initiate the process of fission.

Chilian Actiniæ.†—J. Playfair McMurrich reports on L. Plate's collection of Actinians from the coast of Chili. He divides the simpler Actinians into families, recognising in addition to the Edwardsidæ, which will include the Edwardsiæ, Halcampidæ, and the genus *Scytophorus*, the Gonactiniidæ, which will include *Gonactinia*, Protanthea, and possibly *Oractis*, the Peachiidæ, including *Peachia*, *Eloactis*, and *Haloclava*, and the Ilanthidæ, having essentially the limitations recognised by Andres. Altogether 27 species are dealt with.

The Mesenteric Musculature of Actiniaria.‡—O. Carlgren contributes some details regarding these muscles and their homologies. One or two of his points may be given. The basilar muscles arise in the Actiniaria later phylogenetically than the parieto-basilar and the parietal muscles. The lower Actiniaria (Protanthea, Athenaria, and the Discosomidea among the Stichodactylineæ) have in their mesenteric musculature no homologue to the basilar muscles, which develop only with the growth of a true creeping base. In the Athenaria the parietal muscle which is found on the same side as the transverse mesenterial muscles is homologous with the parietal basilar muscle of the higher

* Univ. California Publications, i. (1904) pp. 211–26.
† Zool. Jahrb., Supplementband vi., Fauna Chilensis, 1904, pp. 215–306 (6 pls. and 5 figs.).
‡ Zool. Anzeig., xxviii. (1905) pp. 510–19.

Actiniaria and the Protanthea, and is only a further development of this muscle.

Morphology of Coral Polyps.*—J. E. Duerden sums up his conclusions as to the relationships of Madreporarian corals. With the exception of the characteristics dependent on the presence of a skeleton, the Madreporaria present no feature which separates them from ordinary hexameral Actinians. The development and arrangement of the mesenteries and the tentacles in both the protocnemic and metacnemic stages are the same in both groups. In the absence of siphonoglyphs from the stomodæum, and of lateral ciliated bands from the mesenterial filaments, coral polyps differ from the great majority of anemones, but some of the lower Actinians are without siphonoglyphs, and have but simple filaments.

Modern Actiniaria (excluding the Ceriantheæ and Zoantheæ) and Madreporaria constitute a single group, one section of which forms a skeleton which is absent in the other.

On the other hand, the Palæozoic rugose corals diverge from modern corals after the formation of the six primary septa; their septa are then added in the same sequence as are the mesenteries in the Zoantheæ; further, the single ventral siphonoglyph of the Zoanthids was probably present in the rugose polyp, being now represented on the skeleton by the "fossula." The Rugosa and Zoantheæ undoubtedly constitute a common group of skeleton-forming and skeletonless polyps, just as do the modern Madreporaria and ordinary hexamerous Actiniaria.

Protozoa.

Behaviour of Lower Organisms.†—H. S. Jennings has published an important series of investigations on the reactions of Protozoa, Planaria, and Rotifera to heat, light, and other stimuli. Seven memoirs are included in the volume. The theory of tropisms, the consideration of physiological states as determining factors in the behaviour of these organisms, and the method of trial and error in their behaviour, are subjects discussed on the basis of the experimental data. One or two conclusions only can be quoted. The author decides that the theory of tropisms does not go far in helping us to understand the behaviour in question; on the contrary, it is when accurately studied as a rule inconsistent with its fundamental assumptions. In *Stentor* and *Planaria* it is proved that to the same stimuli, under the same external conditions, the same individuals react at different times in radically different ways, showing the existence of different physiological states which determine the nature of the reaction. The behaviour of the lower organisms is flexible, by the method of trial and error. This method involves many of the fundamental qualities seen in higher animals, yet with the simplest possible basis in ways of action; a great portion of the behaviour consisting often of but one or two definite movements—movements that are stereotyped when considered by themselves, but not stereotyped in their relation to the environment. This

* Smithsonian Misc. Collections, xlvii. (1904) pp. 98–111 (16 figs.).

† Publications of Carnegie Institute, Washington, No. 16 (1904) pp. 1–256.

method leads upward, offering at every point opportunity for development, and showing, even in the unicellular organisms, what must be considered the beginnings of intelligence (objective) and of many other qualities found in higher animals. Tropic action doubtless occurs, but the main basis of behaviour is in these organisms the method of trial and error.

New and little-known British Freshwater Rhizopods.*—James Cash describes from Mid-Cheshire and Essex a number of interesting Rhizopods: a naked reticularian form, *Penardia mutabilis* g. et sp. n.; an Arcellid with central digitate and lateral more elongated and acicular pseudopodia, *Difflugiella apiculata* g. et sp. n.; besides *Amœba pilosa* sp. n., *Mastigamœba aspera* F. E. Schulze, *Gymnophrys cometa* Cienk., and *Vampyrella flabellata* sp. n.

Longitudinal Division in Opalina ranarum.†—H. Schouteden records the occurrence in *Opalina* of division lengthwise. The process goes on comparatively slowly, a gradually deepening furrow appearing first; when this has almost divided the animal, the two halves swim sharply apart, and the bridge between tears with a snap. The whole process was observed, and is not to be regarded as a case of conjugation.

Trypanosomes and Hæmogregarines of Teleosts.‡—E. Brumpt describes several new species of these from *Gobius*, *Callionymus*, *Cottus*, etc. There are two distinct types of Trypanosome, one resembling that of the skate, the other that of the mammals, particularly of the rat.

Culture of a Frog's Trypanosome in a Leech.§—A. Billet finds that *Trypanosoma inopinatum* of the green frog of Algeria thrives well in the alimentary canal of the leech *Helobdella algira*, which often occurs on the frog. The Trypanosome is rare in the frog, but forms of *Drepanidium* are common—yet *Drepanidium* is not found in the leech. It is suggested that there may be a metamorphosis of the *Drepanidium* into the Trypanosome, just as Schaudinn has described the transformation of *Hæmogregarina ziemanni* into a Trypanosome.

Hæmoflagellates in Teleosteans.‖—C. Lebailly finds *Trypanosoma platessæ* sp. n. and *Hæmogregarina platessæ* together in *Platessa vulgaris*, and two similar pairs, also new species, co-existent in *Flesus vulgaris* and *Platophrys laterna*. The occurrence of the two forms in one host is to be considered in relation to the researches of Schaudinn and Billet on the probable relationship of the two types.

Anisogamy in Gregarines.¶—L. Brasil observes that in *Urospora*, and very probably in *Gonospora*, two kinds of gametes exist, that conjugating gametes are unlike, and that each of the two associated Gregarines give rise to only one kind of gamete.

Hæmosporidia of Rana.**—J. H. Stebbins, jun., has found in the blood of *Rana catesbiana* several forms of *Hæmogregarina catesbianæ*,

* Journ. Linn. Soc. (Zool.) xxix. (1904) pp. 218–25 (1 pl.).
† Zool. Anzeig., xxviii. (1905) pp. 468–9.
‡ Comptes Rendus, cxxxix. (1904) pp. 613–15.
§ Tom. cit., pp. 574–6. ‖ Tom. cit., pp. 576–7.
¶ Arch. Zool. Exp., iii. (1905) pp. 17–38 (1 pl.).
** Trans. Amer. Micr. Soc., xxv. (1904) pp. 55–62 (2 pls.).

among which may be mentioned, the merozoite or spore; the trophozoite and cytocyst of the asexual cycle; the micro- and macrogametocytes, oocyst, and sporozoite of the sexual cycle, in which the microgametocyte is extra-corpuscular, while the macrogametocyte is both extra- and intra-corpuscular. Infection may be induced by the food taken into the animal's digestive tract, as well as by other causes. Schizogony and sporogony occur in the red blood-corpuscles of the same host; in the asexual cycle, multiplication is effected by segmentation, or sporulation. After many generations of schizogony, the sexes become differentiated into macro- and microgametocytes, and conjugate by some means not yet discovered. The extra-corpuscular macrogametocyte, after fertilisation, penetrates a red blood-corpuscle and becomes encysted; from the cyst-nucleus arise sporoblasts, which in turn are converted into sporozoites. These rupture the oocyst and escape into the plasma, where they are ready to invade fresh blood-corpuscles.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Structure of the Cell of the Cyanophyceæ.—Papers on this hotly-contested subject still continue to appear. F. G. Kohl* gives a general summary of his large work on this subject, which appeared a short time ago, and replies to certain criticisms of Brandt. The work of E. W. Olive,† however, is of the most importance, for by the use of modern methods of fixation, staining, and section-cutting, he claims to have clearly established the existence of mitotic nuclear division in this group. The central nucleus appears to be in a state of continuous mitotic division; only in the spores and heterocysts do the nuclei enter the condition of rest and exhibit a nuclear vacuole and membrane. The ordinary nucleus shows a distinction into a more or less dense or chromatic portion, which encloses a number of minute chromatin granules, the chromosomes, which are of constant number in a given species—8 in *Nostoc commune*, for example, and 16 in *Oscillatoria tenuis*. During actual division there is a definite spindle, and the chromosomes undergo fission, the whole spireme thread, which consists of the chromo somes in a row, undergoing a longitudinal fission. The cell divides by the growing-in of a ring-shaped wall.

O. P. Phillips ‡ has made a comparative study of the cytology and movements of the Cyanophyceæ. He regards the central body in the cell as a nucleus, and describes sexual fusions in the formation of the spores. He finds that the chromatin of the central body is aggregated in hollow vesicles in the resting cell. This vesicular appearance disappears in the dividing cell, and the chromatin granules become arranged in a loose network, and multiply by transverse division. Nuclear division follows, in one of two ways, both occurring in the same species. One method corresponds to a direct division; the other is a primitive form of karyokinesis, and resembles the method of mitosis described by Kohl, in which a double transverse division occurs in the spirem thread, never a longitudinal splitting. The author also found thick-walled spores in *Oscillatoria*, produced after the fusion of several cells, and after adjoining "nurse-cells" have disintegrated and given up their chromatin to the spore-cell. This fusion is regarded as a sexual act. He also states that the movements of the Cyanophyceæ are caused by delicate cilia distributed along the sides of the filament.

* Beih. Bot. Centralbl., xviii. (1904) pp. 1–8.
† Tom. cit., pp. 9–44 (1 pl.).
‡ Contr. Bot. Lab. Univ. Pennsylvania, ii. (1904) pp. 237–335 (3 pls.). See also Bot. Gazette, xxxix. (1905) pp. 228–9.

On the Size of the Nucleus.*—J. J. Gerassimow describes in detail, with tables, his observations on cells of *Spirogyra*, which, by abnormal conditions (cooling, etherisation, etc.), have been caused to divide into cells without nuclei and cells with either a single very large nucleus or two nuclei.

Structure and Development.

Vegetative.

Course of Laticiferous Tubes in Leaves.†—Oscar Mayus has studied the laticiferous tissue in the leaves of members of the Moraceæ, Papaveraceæ, Euphorbiaceæ, Apocynaceæ, Asclepiadaceæ, and Compositæ, and comes to the following conclusions:—The laticiferous tubes in the leaf-blade form, with those present in other parts of the plant, a perfectly continuous system. Latex-tubes, peculiar to the leaf, do not occur. Generally, the latex-tissue accompanies the vessels; from this point of view we can distinguish three classes of latex-tube endings: (*a*) the tubes end along with the vessels; (*b*) they pass beyond the vascular bundle and run free in the parenchyma; (*c*) they run from the lower to the upper epidermis of the leaf. In addition to H and net-like anastomoses, those of loop-form also occur. From the nerves of the third order onward, latex-tubes take the place of sieve-tubes. Starch is always present in the cells surrounding the free running latex-tubes.

Structure and Development of Epiphegus virginiana.‡—E. Cooke and Schively have made a study of this parasite, a member of the Orobanchaceæ. They find that the haustoria are not developed on the parasite, but arise from the roots of the beech, the host-plant. The embryo is rudimentary. Bicollateral bundles occur both in the tuber and in the aerial shoot.

Secretory Apparatus of the Dipterocarpeæ.§—P. Guérin has studied the mode of development and the course of the secretory canals in the wood of species of *Dipterocarpus*. The canal arises by separation of four cambial cells, which are precisely like the other elements of the cambium, and, contrary to the method of development usual in other plants, these four cells do not result from the division of a single mother-cell. The canal may retain this original form, or it may be found at a later stage bordered by a larger number of cells, the increase in the number being due not to a radial division of the original four, but to their tangential separation, whereby a larger number of cambial cells is involved. The diameter of the canal hardly increases with age, but at a given time, the thin walls of the secreting cells which limit the canal give way, and the original border more or less completely disappears. Tangential sections show an anastomosing between some of the canals during their sinuous longitudinal course.

Pitcher-formation in Saxifrages.‖—J. Mahen and X. Gillot have studied the teratological formation of pitchers in *Saxifraga ciliata*, in

* Beih. Bot. Centralbl., xviii. (1904) pp. 45–118 (2 pls.).
† Tom. cit., 1905, pp. 273–86 (17 figs. in text).
‡ Contr. Bot. Lab. Univ. Pennsylvania, ii. (1904) pp. 352–98. See also Bot. Gazette, xxxix. (1905) p. 239. § Comptes Rendus, cxl. (1905) pp. 520–2.
‖ Journ. de Bot., xix. (1905) pp. 27–39 (7 figs in text).

which they find the following types:—Transformation of the leaves into pitchers, formation of pitchers upon the leaves, and formation of supernumerary leaflets by proliferation of the nerves. The pitcher-like leaf results from a compression of the young leaf in the bud, resulting in a peltate widening development at the petiole; it does not arise from union of the leaf-margins. As such leaves are met with in many different types from various localities, the action of the environment as a cause of the deformation may be eliminated, nor is there evidence of any parasitic action. The author also describes the occurrence of abnormal vascular bundles in the pith of Saxifrages; the pith bundles show inverse orientation, wood external and bast internal, and seem to be due to a lateral proliferation of the cambial cells. He also describes in the neck of the pitchers, wood islands, of primary origin, which have become separated from the cambium by normal parenchyma.

Anatomical Investigations on Stem-galls.*—C. Houard has studied in a large number of plants the structure of the so-called "terminal" galls, which are characterised by arrest in the growth in length of the internodes at the end of the stem, an increased diameter of the affected region, and the consequent crowding of the leaves. In a previous memoir the author has dealt with the "lateral" galls, those in which growth in length of the internodes is not arrested. The following are the general conclusions arrived at:—The parasite affects the growing point of the stem, setting up an action which finds expression in the hypertrophy and cellular hyperplasy of the surrounding tissues. Increase in length of the shoot is arrested or stopped; the upper internodes remain short, and show a corresponding increase in thickness, as well as important anatomical modifications. Cortex and pith are generally more developed, while the numerous fibro-vascular bundles are scattered irregularly and without regular orientation. There is also absence of periderm, and poor formation of secondary tissues. Associated with the arrest in growth of the internodes is a diminution in growth in length of the leaves, which become broader, thicker, and covered with hairs. Their internal structure is generally much modified, showing arrest in differentiation of the tissues—diminution of chlorophyll-containing tissue, stomata irregular and without order, more numerous hypertrophied vascular bundles, with irregular primary wood and slight secondary formation. As a result the gall assumes a tufted form, like an artichoke or large bud; the original symmetry of the shoot is preserved, as the attack of the parasite is at the growing point. The phyllotaxy of the shoot attacked remains normal. Owing to interruption of the terminal growth, lateral branchlets become developed. After the departure of the parasite, growth is sometimes resumed in the shoot affected, and the internodes become elongated.

Regeneration in Passion-Flower.†—Hans Winkler describes the formation in *Passiflora cærulea* of adventitious shoots on tendrils which had been cut from the plant and kept moist in sand. After several

* Ann. Sci. Nat., ser. 8, xx. (1904) pp. 219-385 (289 figs. in text).
† Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 45-8 (1 fig. in text).

months two shoots and a root had developed from the callus, which was formed at the cut end of the tendril. Roots and shoots will develop also on the leaves of the same plant, and on isolated portions of internodes.

Reproductive.

Gametophyte and Embryo of Torreya taxifolia.*—J. M. Coulter and W. J. G. Land have studied these stages in the life-history of this plant, which occurs in a narrow belt on the east side of the Apalachicola River, extending from the southern boundary of Georgia for about 30 miles southward. It grows associated with mesophyte vegetation, such as characterises the beech-maple-hemlock forms of the woods of the northern States, and has a great capacity for vegetative reproduction.

The staminate strobilus consists of a series of closely overlapping sterile bracts, in four vertical rows, enveloping the tip of the axis, which bears numerous stamens. The large adaxial resin cavity which occurs in the stamen occupies the site of three abortive sporangia. The male gametophyte has no prothallial cell, and the male cells are very unequal, resembling those of *Taxus*. The pollen-tube is very variable in the rate and direction of its advance through the nucellar cap, sometimes pushing in the embryo-sac while it is in an early free-nucleate stage. The ovulate strobilus consists of four enveloping bracts, and a single terminal ovule with two integuments. Extensive intercalary growth below the mother-cell forms the bulk of the mature ovule and seed. There is no special digestive layer around the mother-cell. The solitary archegonium initial appears as soon as walls are formed, is always at one side of the central axis of the gametophyte, and forms a two-celled neck. The nucleus of the central cell was not seen to divide, and no trace was found of a ventral nucleus. In fertilisation the male cytoplasm invests the fusion nucleus, and seems to remain distinct until wall-formation at the four-nucleate stage of the pro-embryo.

In the development of the pro-embryo, four free nuclei appear before wall-formation, and the pro-embryo completely fills the egg, having no "open cells." A pro-embryo of 12–18 cells is the winter stage. In the spring the suspensor is formed by what may be called a wave of elongation, beginning with the uppermost tier of the pro-embryo and extending gradually downward, tier after tier, until it includes the upper region of the meristematic cylinder formed by the terminal cell. Small embryos are formed in the second season in the suspensor region of the normal embryo, but whether they arise from the prothallial or suspensor cells was not determined. The rumination of the endosperm peculiar to *Torreya*, among the Gymnosperms, arises from the extremely irregular encroachment of the endosperm upon the perisperm.

Parthenogenesis in Wikstrœmia indica.†—Hans Winkler describes the occurrence of parthenogenesis in this member of the Thymelæaceæ. The pollen is apparently incapable of germinating. In absence of

* Bot. Gazette, xxxix. (1905) pp. 161–78 (4 pls.).
† Ber. Deutsch. Bot. Gesell., xxii. (1905) pp. 573–80.

pollination embryos developed, and were proved to arise from the unfertilised oospheres.

De Candolle, Augustin — **La parthénogenèse chez les plantes d'après les travaux récents.** [A review of recent work on parthenogenesis in plants, with some general remarks.] *Arch. Sci. Phys. et Nat. Genève*, cx. (1905) pp. 259–72.

Guignard, L.—**La double fécondation chez les Malvacées.** (Double fertilisation in the Malvaceæ.)
[The author describes the details of the process of double nuclear fusion in members of this order, especially *Hibiscus Trionum*.] *Journ. de Bot.*, 1904, pp. 296–308, figs. in text.

Physiology.

Nutrition and Growth.

Mechanical Adjustment in Cereus giganteus to Varying Quantities of Stored Water.* — Effie S. Spalding has made a series of measurements and observations at the Desert Laboratory in the Southern United States, to determine the relation of the fluted columnar cactus type to varying amounts of water-storage. The strong ribs and corresponding furrows suggest a ready adjustment by a bellows-like action of the ribs and furrows to changes in bulk due to varying amounts of stored water. A cross-section of a stem of a giant cactus shows a heavy band of thick-walled, sub-epidermal tissue, which is very strong and elastic. Beneath this is a band of thin-walled chlorophyll cells, and all the tissue between this and the ring of fibro-vascular bundles is made up of thin-walled water-storing cells. The construction suggests that a change in bulk corresponding to varying quantities of stored water could hardly affect the central mechanical cylinder, but would probably manifest itself externally by expansion or contraction of the circumference effected by folding or unfolding of the ribs and furrows. These suggestions were borne out by the results of experiment—changes in the circumference were found to be accompanied by such action of the ribs, and these movements are directly correlated with increase and decrease in the amount of water supplied to the plant. Variations in the circumference of the stem, due to changes of water-content, are not the same at all heights, but are least pronounced at the base and top.

Study of Endotropic Mycorhiza.†—J. Gallaud begins with an historical account of Mycorhiza generally, of its discovery, and of the many papers that have been published on this much-debated subject. He then gives an account of his own research on endotropic forms. He distinguishes four series or types: (1) The *Arum* series, in which the roots are usually invaded by the fungus, though occasionally free. The infected roots are more opaque, rigid, and hard; they are bent and twisted, and break more easily at those points where the hyphæ are most abundant. The mycelial filaments pierce the cells of the three outer layers of the root; they are intra-cellular. They then spread through the intra-cellular spaces, but branches from the hyphæ pierce the cells

* Bull. Torrey Bot. Club., xxxii. (1905) pp. 57–68 (2 pls. and 9 figs. in text).
† Rév. Gén. Bot., xvii. (1905) pp. 5–48, 66–85 (4 pls.).

and form in the interior ramifications of very slender filaments. The same type is found in the larger number of Monocotyledons. In Dicotyledons it occurs in *Stachys*, *Teucrium*, *Bellis perennis*, *Orobus tuberosus*, *Fragaria vesca*, etc.

The second series is typified by *Paris quadrifolia*. The mycelium is constantly intracellular, infection being limited to the four outer layers of cells. Much-branched hyphæ forming tufts are constantly present. *Colchicum autumnale*, several Ranunculaceæ and Violaceæ, etc., belong to the *Paris* series. In the Hepatics, which form a third series, he finds that the fungus is intra-cellular, and inhabits the thallus, which spreads over the surface of the soil; tufts and sporangioles are formed by the mycelium. The Orchideæ present yet another type; the intra-cellular hyphæ form compact coils, which remain intact (Pilzwirthzellen), or become digested by the host (Verdauungzellen). The author finds a somewhat similar condition of growth in the roots of *Tamus communis* and *Psilotum triquetrum*.

It has been impossible, in the absence of fructification, to identify any of the fungi. In each series, which embraces a varied collection of host plants, the fungus is throughout of the same nature. And probably it will be found that there are only a few species that form Mycorhiza.

Hemicellulose as a Reserve Substance in European Forest-Trees.*—H. C. Schellenberg points out that the mucilaginous, or cellulose, layers described in the interior of the bast fibres in various trees during the period of winter rest is really hemicellulose, and is to be regarded as a carbohydrate reserve, which disappears in the spring. The author has demonstrated the existence of similar reserves of hemicellulose elsewhere, as in the parenchyma of the cortex and in the collenchyma.

Heterorhizy in Dicotyledons.†—A. Tschirch finds that the roots of many dicotyledonous plants show a differentiation into nutritive and attaching. The attaching roots, those that is, which serve to fasten the plant in the soil, are characterised by the presence of mechanical tissue, by the absence of pith, and by their larger stele.

Irritability.

Geotropic Response in Stems.‡—Julia A. Haynes conducted a series of experiments with a view to determine the angle of deviation from the normal vertical position at which stems show the strongest geotropic response. Unbranched stems and actively growing young plants formed the subject of experiment. Two methods were used—that of "alternating stimulation" and the "after-effect" method. In the former, by means of a special frame devised for the purpose, plants were set first at an angle of 90° on one side of the vertical, and then at an angle of 135° on the other side, or *vice versa*. Of the 395 plants used, 53 did not respond in the time given to the experiment. Of the

* Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 36–45.
† Flora, xciv. (1905) pp. 68–78.
‡ Amer. Nat., xxxix. (1905) pp. 77–85 (1 fig.).

remainder, 331, or 96·8 p.c., responded better for the deviation of 90°; 11, or 3·2 p.c., for the deviation of 135°. In the second method, orthotropic plant members are exposed to the one-sided action of gravitation by being placed out of their normal position; but before a geotropic curve has time to appear, the plant is put upon the klinostat, and so revolved that the further curving effect of gravitation is neutralised during the revolution. Thus, any geotropic influence induced in the plant before it was placed on the klinostat, has opportunity to show itself. If the gravitation effect on plants differs according to the deviation of the plant from its normal position, we may expect the size of the after-effect angle attained on the klinostat to be greatest when the previous exposure of the plant was made at the angle of optimum stimulation. The results obtained were less satisfactory than with the previous method, but when any difference in after-effects could be observed, it was in agreement with the results of the alternation experiments. Hence there is strong evidence that stems respond better to the gravity stimulus when their angle of deviation from the normal position is one of 90° than when it is one of 135°; and since the question seems to have been narrowed to these two angles by previous workers, it may be claimed that the angle of deviation from the vertical at which stems show the strongest geotropic response is one of 90°.

Distribution of Statoliths in Roots.*—G. Tischler has studied the distribution of starch grains in ageotropic, or slightly geotropic roots. He finds that in adventitious roots which are constantly ageotropic, starch-grains are either not present in the root-cap, or, if present, are irregularly distributed; and the same holds for temporarily ageotropic roots. When roots become slightly geotropic, the starch-grains appear and function as statoliths. The author suggests that in certain aerial roots of orchids, which are slightly geotropic but do not contain starch-grains, the chloroplasts of the root-cap act as statoliths.

The Effect of Low Temperature on Zoospores of Algæ.†—E. C. Teodoresco describes four experiments made by him on the zoospores of *Dunaliella* in very low temperature. In one case zoospores of the alga were placed in very concentrated salt water, and exposed for three months to a temperature which at times went as low as 20° below zero. The zoospores remained alive and in good condition. They did not encyst, nor pass into the Protococcoid state. In another experiment, zoospores of the same alga were placed in a tube of salt water concentrated to 38° Baumé, and the tube was sunk for six minutes into a mixture of equal parts of snow and alcohol. The temperature varied between −30° and −29°, but the zoospores remained alive and swam about with ease. The same tube was then placed in the freezing mixture for thirty minutes, during which time the temperature varied between −30° and −26°. The salt formed a transparent layer at the bottom of the tube, while the water above it was transformed into a sort of opaque, whitish, soft snow. After 30 minutes the tube was removed to a temperature of −2°, where the snow melted. The zoospores were found to be for the most part alive and mobile; and when placed in a

* Flora, xciv. (1905) pp. 1–68. † Comptes Rendus, cxl. (1905) pp. 522–4.

hanging drop, they collected on the side opposite to the light. The dead zoospores were, doubtless, those which had been pierced by or imprisoned in the crystals formed by the low temperature. Those zoospores which had been in the layer of separating water, were still in good condition.

Chemical Stimulation of a Green Alga.* — B. E. Livingston describes his experiments on a species of *Stigeoclonium* and their results. Thirty different reagents were tried on the filaments, and the author comes to the following conclusions: Nitrate and sulphate, in the case of a large number of metallic elements, act in the same way and at the same concentration upon the filamentous form of this alga. He concludes that the stimulation is due to the cations. At high enough concentrations death is produced. The change produced at somewhat lower concentrations is strictly parallel, in form of cells and manner of cell division, to that caused by extraction of water, or inhibition of its absorption. At this lower concentration, and at a still lower one, there is a marked acceleration in the production of zoospores. This is exactly the opposite of what results from water-extraction. The acceleration in zoospore activity gradually decreases with weaker solutions until the normal behaviour is reached. The work and results of other authors are compared with the present research.

Germination of Spores.†—F. W. Neger finds that the spores of *Bulgaria polymorpha* germinate readily under the chemical stimulus of plant-remains, such as bark, leaves, or wood of oak or pine. It is sufficient if the bark, etc., be in the immediate neighbourhood, though the influence is more marked when they form part of the culture medium. He notes also the influence of temperature on germination.

Chemical Changes.

Action of Wood on Photographic Plates.‡ — H. Marshall Ward refers to W. J. Russell's recent memoir,§ in which is described the action of a number of different kinds of woods on a photographic plate in the dark; after a period of varying length, during which the smooth dry face of a wood block has been in contact with the plate, the latter, on development, may show an image. Russell had suggested hydrogen peroxide as the active agent, and the resin in the wood as probably the indirect causal agent, in support adducing the experimental result that while gum-like bodies are inactive, those of a more resinous nature are active. The author, as the result of a number of experiments, concludes that the activity is due not merely to resin or resin-like bodies, but that tannin and tannin-like bodies, as well as some others, may be responsible. It is at any rate clear that some body or bodies in the liquefied cell-walls reduce silver-salts in the plate, and that these bodies are either shot off, as if volatile, or diffuse readily, seems clear from the want of sharpness in the microscopic details.

* Bull. Torrey Bot. Club, xxxii. (1905) pp. 1-34 (17 figs.).

† Naturwiss. Zeitschr. Land. Forstw., ii. (1904) p. 484-90. See also Ann. Mycol., iii. (1905) pp. 116-17.

‡ Proc. Camb. Phil. Soc., xiii. (1905) p. 3-11.

§ Phil Trans. Roy. Soc., cxcvii. ser. B (1904) pp. 281-9.

General.

Botany of Funafuti.*—J. H. Maiden gives a short account of the botany of this island, based on collections made by Mrs. Edgeworth David. The plants enumerated comprise 38 species of Dicotyledons, 12 Monocotyledons, 5 Vascular Cryptogams, and 1 Lichen, all more or less widely distributed in the Pacific Islands as inhabitants of other coral islands, or of the coastal tracts of the larger islands. As regards the means by which the island was populated, the author enumerates 21 species which have floating seeds, 6 with succulent fruits which are eaten by birds, and 3 the fruits of which form a burr. The seeds of the grasses (4 in number), a *Scirpus* and *Jussieua*, may have been brought on the feet of birds, or the roots of various introduced plants. The 4 ferns and *Psilotum* probably arrived as wind-borne spores. Several plants have been purposely, and others, widely diffused weeds, probably accidentally introduced by man.

West Australian Droseras.†—A. Morrison describes a new bulb-forming *Drosera* (*D. bulbigena*) from West Australia, and discusses the the formation of the bulb in this and other West Australian species. In *D. bulbigena* the bulb, when enveloped in thick dark brown scales, is developed from the enlarged extremity of the root-stock by a process of budding from its lower surface. Where several bulbs arise, the process has been repeated, each successive one being formed on the end of a prolongation of the axis from the base of the preceding bulb.

Autophytography: A Process of Plant Fossilisation.‡—C. H. White discusses the process of plant fossilisation, whereby the plant undergoing decomposition reproduces itself in outline on the rock surface upon which it rests, or upon the matrix in which it is enclosed, either by the precipitation of coloured mineral matter, or by the alteration or removal of the colouring matter already in the rock. For such plant pictures the author proposes the name "autophytograph," and discusses their formation in certain individual cases. A black adherent deposit, insoluble in water, but slowly attacked by mineral acids, probably contains an oxide of iron. It is suggested that the plants may yield on decomposition a precipitant of iron, which extracts iron from the surrounding solutions, and deposits it in a manner analogous to one of the artificial ink-making processes, and on exposure to air the precipitate is changed to an oxide. Or the conditions of decay may be such that ammonia is liberated in presence of iron in solution, precipitating the iron on the rock, upon which the plant rests during decay. Another case is described in which rootlets have in recent time affected a block of sandstone, dissolving the iron pigment which stained the stone a yellow brown, giving an autophytograph of lighter colour on a dark background.

RANDOLPH, C. B.—**The Mandragora of the Ancients in Folk-lore and Medicine.** *Proc. Amer. Acad. Arts and Sci.*, xl. (1905) pp. 488–537.

* Proc. Linn. Soc. New South Wales xxix. (1904) pp. 539–556.
† Trans. and Proc. Bot. Soc. Edinburgh, xxii. (1905) pp. 417–24.
‡ Amer. Journ. Sci., xix. (1905) pp. 231–6 (5 figs. in text).

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Bailey, C.—**The British Horsetails.**
[A simple account of the structure of *Equisetum*.]
Proc. Manchester Field Club, I. ii. (1905) pp. 316–21.

Beal, W. J.—**Michigan Flora: a list of the fern and seed-plants growing without cultivation.** Reprinted from *Fifth Rep. Michigan Acad. Sci.* (Lansing, 1904) 147 pp.

Christ, H.—**Filices Cadierianæ.**
[Ferns collected by P. L. Cadière in French Annam. Contains some new species.]
Journ. de Bot., xix. (1905) pp. 58–68.

" " **Primitiæ Floræ Costaricensis. Filices et Lycopodiaceæ. III.** (First-fruits of the flora of Costa Rica. Ferns and Lycopods.]
[Conclusion, with an appendix and corrections.]
Bull. Herb. Bois., v. (1905) pp. 248–60.

Christensen, C.—**On the American species of Leptochilus, sect. Bolbitis.**
[The author criticises Underwood's resuscitation of certain old generic names for ferns, and shows that *Leptochilus* Kaulf. (1824) has precedence of *Anapausia* Presl, revived by Underwood for the group of Acrosticha with irregularly netted veins. The section *Bolbitis* contains eight tropical American species, for which a key is given; it is followed by detailed descriptions and critical notes and figures.]
Bot. Tidskr., xxvi. (1904) pp. 283–97 (figs.).

" " **A new Elaphoglossum from Brazil.**
[*E. didymoglossoides*, with proliferous sterile leaves, and very thin texture.]
Tom. cit., pp. 299–300.

Copeland, E. B.—**Ferns in Perkins' Fragmenta Floræ Philippinæ.**
[Contains descriptions of 1 new genus (*Christopteris*), 38 new species, and 3 new varieties of ferns, collected by the author.]
Borntraeger (Leipzig, 1905) pp. 175–94 (1 pl.).

Diels, L.—**Die primitivste Form von Lygodium.** (The most primitive form of *Lygodium*.)
[This is not *L. articulatum*, but the little-known *L. hians* Fourn., which is simpler in its branching and less differentiated.]
Hedwigia, xliv. (1905) pp. 133–6 (1 fig.).

Fischer, H.—**Die Farne in Hohen Venn.** (Ferns of the Hohe Venn.]
Verh. Naturh. Ver. pr. Rheinlande, etc., lxi. (1905) pp. 1–9.

Hieronymus, G.—**Einige Berichtigungen zu der Abhandlung: "Plantæ Lehmannianæ in Guatemala, Columbia et Ecuador regionibusque finitimis collectæ, additis quibusdam ab aliis collectoribus ex iisdem regionibus allatis determinatæ et descriptæ. Pteridophyta," in Engler's Bot. Jahrbüchern, Bd. xxxiv. pp. 417–582.** (Some corrections of the paper, "Plants collected by Lehmann in Guatemala, Columbia, Ecuador, and the neighbouring regions, determined and described, together with some additions brought from the same regions by other collectors. Pteridophytes.") *Hedwigia*, xliv. (1905) pp. 179–80.

Maxon, W. R.—**On the names of three Jamaican species of Polypodium.**
[An identification of the true *P. myosuroides* of Swartz, Schkuhr's plant being re-named *P. delitescens*. Also *P. saxicola* Sw. is maintained as distinct from *P. saxicolum* Baker, here re-named *P. induens*.]
Bull. Torrey Bot. Club, xxxii. (1905) pp. 73–5.

PAULSEN, O.—**Lieutenant Olufsen's second Pamir-Expedition. Plants collected in Asia-Media and Persia. II.**
[Contains nine ferns.] *Botan. Tidsskr.*, xxvi. (1904) pp. 251–74.

PRAIN, D.—**The Vegetation of the districts of Hughli-Howrah and the 24-Pergunnahs.**
[Annotated list, containing 31 vascular cryptogams.]
Records Bot. Survey of India, iii. (1905) pp. 143–339.

SCHNARF, K.—**Beiträge zur Kentniss des Sporangienwandbaues der Polypodiaceen und der Cyatheaceen und seiner systematischen Bedeutung.** (Contributions to a knowledge of the structure of the sporangial wall in *Polypodiaceæ* and *Cyatheaceæ*, and its systematic significauce.)
SB. Akad. Wiss. Wien, cxiii. pp. 549–72 (1 pl.).

SHIBATA, K.—**Studien über die Chemotaxis von Isoëtes-Spermatozoiden.** (Studies of the chemotaxis of the spermatozoids of *Isoetes*.)
Ber. Deutsch. Bot. Ges. xxii. (1904) pp. 478–84.

UNDERWOOD, L. M.—**The early writers on Ferns and their Collections. IV. Presl, 1794–1852; John Smith, 1798–1888; Fée, 1789–1874; and Moore, 1821–1887.**
[Brief biographical sketches of these authorities, with critical estimates of the value of their work.] *Torreya*, v. (1905) pp. 37–41.

WIGGLESWORTH, G.—**The papillæ in the epidermoidal layer of the Calamitean root.**
Ann. Bot., xviii. (1904) pp. 645–8 (3 figs.).

Bryophyta.

(By A. GEPP.)

BAGNALL, J. E.—**Zygodon Forsteri in Worcestershire.**
[Records the discovery of this rare moss near Harvington; previously it was known only from Essex, Sussex, and Somerset.]
Journ. Bot., xliii. (1905) pp. 129–30.

BARTH, J.—**Die Flora des Hargita-Gebirges und seiner nächsten Umgebung.** (The flora of the Hargita Mountains and their immediate environs.)
[Contains lists of 28 hepatics and of 96 mosses.]
Magyar Bot. Lapok, iv. (1905) pp. 8–18.

BAUER, E.—**Bryotheca Bohemica. Bemerkungen zur dritten Centurie, ein Beitrag zur Kentniss der Laub- und Lebermoose Böhmens.** (Bohemian moss herbarium. Remarks on the third century, a contribution to a knowledge of the mosses and hepatics of Bohemia.) *SB. Deutsch. Nat. Med. Ver. Böhmen "Lotos,"* xxiv. (1904) pp. 134–43.

BEST, G. N.—**A Lesson in Systematic Bryology.**
[Having found *Thuidium hystricosum* in the United States, and examined many specimens of *T. abietinum*, the author shows the former to be simply a form of the latter; and then proceeds to discuss the meaning of the species in mosses, the uncertainty caused by variability, and the crime of founding a species on a single specimen. The true conception of a species is only to be acquired from a study of many specimens from many localities.
Bryologist, viii. (1905) pp. 17–22 (1 pl.).

BÖRGESEN, F., & C. JENSEN—**Utoft Hedeplantage. En floristisk Undersögelse af et Stykke Hede i Vestjylland.** (Open heath vegetation. A floristic investigation of a piece of heath in West Jutland.)
[An analysis of the plants, including mosses, hepatics, and lichens.]
Botan. Tidsskr., xxvi. (1904) pp. 177–221.

BROTHERUS, V. F.—**Engler und Prantl's Die Naturlichen Pflanzenfamilien. Lief. 222. Musci.** (Engler's and Prantl's The natural families of plants. Part 222. Mosses.
[Continuation, treating of Polytrichaceæ, Dawsoniaceæ, Erpodiaceæ, Hedwigiaceæ, and containing an artificial key to the Pleurocarpi.]
Leipzig: Engelmann, 1905, pp. 673–720 (30 figs.).

CARDOT, J.—**Grimmia glauca Card. Espèce nouvelle, ou forme hybride?** (*G. glauca*, a new species, or a hybrid form?)
[A new moss from the French Ardennes, possibly a hybrid between *G. leucophæa* and *G. montana* or *G. trichophylla*.]
Rev. Bryolog., xxxii. (1905) pp. 17–19 (fig.).

" " **Nouvelle Contribution à la Flore Bryologique des Iles Atlantiques.** (Fresh contribution to the moss-flora of the Atlantic islands.)
[A list of 52 species collected in the Azores by B. Carreiro; 13 being new to the islands, 2 new to science, with a new genus —*Alophosia*—founded on *Lyellia azorica* Ren. et Card. The flora of these islands now contains 105 species, 16 of which are endemic and 31 Atlantic.]
Bull. Herb. Boiss., ser. 2, v. (1905) pp. 201–15 (2 pls.).

CARDOT, J., & I. THÉRIOT.—**New or unrecorded Mosses of North America.**
[Descriptions of two new species, translated from *Bot. Gazette*. May 1904.]
Bryologist, viii. (1905) p. 36.

CROCKETT, A. L.—**Rhacomitrium heterostichum gracilescens.**
[Found on Bald Mt., Camden, Maine.] *Tom. cit.*, p. 33.

DAVIES, J. H.—**Some Mosses from County Down.**
[Contains a list of 25 rare Irish mosses, with critical notes. The species were collected in the valley of the Upper Bann, near the coast at Newcastle, and near Killough. *Fissidens rufulus* (with fruit) was found in abundance. Also *F. decipiens*, *Weisia calcarea*, *W. crispata*, *Trichostomum mutabile* var. *cophocarpum*, *Amblystegium fallax*, etc., were gathered.]
Irish Naturalist, xiv. (1905) pp. 1–5.

DOUIN, I.—**Les Anthoceros du Perche.** (Anthoceros-species of the Perche district.)
[Descriptions of, and summary of distinguishing characters of, *A. lævis*, *A. punctatus*, and *A. crispulus*.]
Rev. Bryolog., xxxii. (1905) pp. 25–33 (figs.).

ELENKIN, A.—**Notes Bryologiques.** (Notes on mosses.)
[Chiefly concerned with the moss-flora of the Caucasus.]
Bull. Jard. Impér. Bot. St. Pétersbourg, v. (1905) pp. 23–40.

EVANS, A. W.—**Notes on New England Hepaticæ.**
[Critical notes on six species, the more important being on *Lophozia Kunzeana*, *Chiloscyphus pallescens*, *Jubula pennsylvanica*. Also some lists of additions to the New England Flora.] *Rhodora*, vii. (1905) pp. 52–8.

HAGEN, J.—**Ein Beitrag zur Kentniss der Brya Deutschlands.** (Contribution to a knowledge of the Brya of Germany.)
Norske Vid. Selsk. Skr. Trondhjem (1904) 17 pp.

HAYNES, C. C.—**Notes on a Colony of Hepatics found Associated on a Dead Fungus.**
[On an old sodden *Fomes fomentarius* in the Adirondacks were found *Scapania* (1 species), *Cephalozia* (3), *Riccardia* (1), *Jamesoniella* (1), *Kantia* (1), *Lophozia* (2), *Blepharostoma* (1), and 2 mosses.]
Bryologist, viii. (1905) pp. 31–2.

HERZOG, TH.—**Die Laubmoose Badens. Eine bryogeographische Skizze.** (The moss-flora of Baden. A bryogeographic sketch.)
[Continuation.] *Bull. Herb. Boiss.*, ser. 2, v. (1905) pp. 268–83, 375–90.

" " **Ein Beitrag zur Kenntnis der Barbula sinuosa.** (Contribution to a knowledge of *B. sinuosa*.)
[A criticism of the views of Juratzka and of Correns about the vegetative reproduction of this species, together with an account of laboratory cultures of various fragments of the plant, and a note on its distribution from Britain to the Caucasus. It is a plant of the Atlantic type.]
Beih. Bot. Centralbl., xviii. (1905) pp. 115–18.

HOLZINGER, J. M.—**Some recently-described North American Polytricha.**
[Insists upon the differences between *P. ohioense* and *P. decipiens*. Gives H. Lindberg's description of *P. angustidens*, and reproduces his plate from *Bot. Centralbl.*, xxi. No. 50.] *Bryologist*, viii. (1905) pp. 28–31 (1 pl.).

KINDBERG, N. C.—**New North American Bryineæ.**
[Descriptions of 5 new species from the Yukon, 17 from British Columbia, and 1 from Canada, all collected by J. Macoun: also 2 from the United States, collected by Nelson.] *Rev. Bryolog.*, xxxii. (1905) pp. 33–8.

LIDFORSS, B.—**Ueber die Reizbewegungen der Marchantia-Spermatozoiden.** (On the re-action of the spermatozoids of Marchantia to stimulus.)
Pringsheim's Jahrb., xli. (1905) pp. 65–88.

LILLIE, D.—**Hepatics of Caithness.**
[List of 100 species and 4 varieties, with indication of distribution on hills, plains, or coast.] *Journ. Bot.*, xliii. (1905) pp. 124–7.

LOESKE, L.—**Zweiter Nachtrag zur "Moosflora des Harzes."** (Second supplement to the "Moss-flora of the Harz.")
[A series of critical notes and lists, with two new species.]
Verh. Bot. Ver. Prov. Brandenburg, xlvi. (1905) pp. 157–201.

MACVICAR, S. M.—**New and Rare British Hepaticæ.**
[Critical notes on *Marsupella Bœckii*, *M. Pearsoni* Schiffn. (new species), *Nardia Breidleri*, *Sphenolobus exsectus*, *Lophocolea heterophylla* var. *paludosa*, *Odontoschisma denudatum* var. *elongatum*, *Kantia sphagnicola*, *Scapania nemorosa* f. *uliginosa* Jensen (new form), *S. paludosa* C.M. The author states that *Nardia Breidleri* forms part of the highest vegetation in the British Isles.] *Journ. Bot.*, xliii. (1905) pp. 117–20.

MATOUSCHEK, F.—**Additamenta ad Floram bryologicam Istriæ et Dalmatiæ.** (Additions to the moss-flora of Istria and Dalmatia.)
[Continuation.]
Magyar Bot. Lapok, iv. (1905) pp. 24–7.

" " **Bryologisch-floristische Beiträge aus Mähren und Oest Schlesien.** (Bryological floristic contributions from Moravia and Austrian Silesia.)
[List of 77 hepatics and 232 mosses, of which 8 hepatics and 17 mosses are new to the district.]
Verh. Naturf. Verein. Brünn, xlii. 1903 (1904) pp. 5–24.

MIGLIORATO, E.—**Per la ricerca d'un nuovo genere di epatica (Rhizocephala) rimasto inedito dal Gasparrini.** (A plea for the investigation of a new genus of hepatica, *Rhizocephala*, left unpublished by Gasparrini.)
[Caporale's catalogue of Gasparrini's manuscripts records *Rhizocephala*, and alludes to a drawing of it, but does not state its place of origin. Where these manuscripts are preserved is uncertain, though the herbarium is at Pavia. *Rhizocephala* is not included by Massalongo and Barsali in their lists of Italian hepatics.] *Annali di Botanica, Roma*, ii. (1905), pp. 219–220.

MILDBRAED, J., & E. ULBRICH—**Zwei exkursionen nach dem Lubow-See.** (Two excursions to the lake of Lubow.)
[Contains lists of 5 hepatics and 24 mosses.]
Verh. Bot. Ver. Prov. Brandenburg, xlvi. (1905) pp. 204–10.

MÖNKEMEYER, W.—**Beiträge zur Moosflora des Erzgebirges.** (Contributions to the moss-flora of the Erzgebirge.)
[The author compares the flora with that of the Fichtelgebirge, the latter being richer in mosses, the former in phanerogams. He gives lists of 16 hepatics, 8 sphagna, 108 mosses, of which 31 are new to the district, and 5 are varieties or forms new to science. A note on the relationship of *Hypnum purpurascens* to *H. Rotæ*.]
Hedwigia, xliv. (1905) pp. 181–92.

NICHOLSON, W. E.—**Notes on two forms of hybrid Weisia.**
[Careful descriptions of reciprocal hybrids between *W. crispa* and *W. crispata*, found at Lyme Regis, Maidstone, and Lewes.]
Rev. Bryolog., xxxii. (1905) pp. 19-25 (2 pls.).

" " **Tortula montana var. calva. A correction.**
[*T. aciphylla* var. *mucronata*, reported from Sion (Valais) by the author, proves to be as above.]
Tom. cit. p. 40.

PEKLO, J.—**Einiges ueber die Mycorhiza bei den Muscineen.** (Facts about *Mycorhiza* in the Muscineæ.)
Bull. Internat. Acad. Sci. Bohème (1903) 22 pp. (1 pl.).

PRAIN, D.—**The Vegetation of the Districts of Hughli-Howrah and the 24-Pergunnahs.**
[Annotated list, containing six mosses and two hepatics.]
Records Bot. Survey of India, iii. (1905) pp. 143-339.

RENAULD, F., ET J. CARDOT—**Musci exotici novi vel minus cogniti. X.** (New or little known exotic mosses.) *Bull. Soc. Bot. Belgique* (1904) 116 pp.

SCHIFFNER, V.—**Eine neue europäische Art der Gattung Lophozia.** (A new European species of the genus *Lophozia*.)
[A detailed description of an hepatic intermediate between *L. alpestris* and *L. Wenzelii*; found in Tyrol and Styria; specimens will be issued in the author's Hepat. Europ. exsicc.]
Oesterr. Bot. Zeitschr., lv. (1905) pp. 47-50.

SMITH, A.—**Cryptogams in the Grimsby District.**
[Contains a list of 17 mosses and 5 hepatics from Brocklesby.]
Naturalist, No. 578 (1905) p. 83-4.

STEPHANI, F.—**Species hepaticarum.** (Species of Hepaticæ.)
[Monograph of *Plagiochila* continued; descriptions of 30 South-American species, 10 of which are new.]
Bull. Herb. Boiss., ser. 2, v. (1905) pp. 351-66.

WATTS, W. WALTER—**Some Melbourne Mosses.**
[A list of 30 species, 4 of which are new; also a new hepatic. A few other Victorian and Tasmanian mosses are added.]
Victorian Naturalist, xxi. (1905) pp. 140-2.

WHELDON, J. A., & A. WILSON—**Additions to the West Lancashire Flora.**
[List containing 24 mosses and 6 hepatics.]
Journ. Bot., xliii. (1905) pp. 94-6.

Thallophyta.

Algæ.

(By MRS. E. S. GEPP.)

Marine Algæ of North and West France.*—J. Chalon has published a list of the marine algæ of the coasts of Belgium, France, and the north of Spain, extending from the mouth of the Escaut to Corunna, and including the Channel Islands. The list is compiled from his own and other collections, as well as from the records in literature, and the number of species given in his book reaches 844, besides 377 forms and varieties. He also mentions 92 species which are known from our side of the Channel or from the Mediterranean, often from both ; and are

* Liste d. Algues marines, etc., Anvers (1905) 259 pp. (5 figs. in text).

probably present on the coasts of France, with which he deals. Additional information has been gathered from the MS. of Van Heurck's Prodromus of the marine algæ of north-west France and from Malard's notes on Tatihou, which were both at the disposition of the author. A Florule of Tatihou forms an appendix to this volume. Interesting topographical and distributional notes are given in the introductory portion.

Algæ of Lake Baikal.* — V. Dorogostaïsky has made a careful examination of the algæ of Lake Baikal and its basin. He finds that the monotony and small number of species represented form a marked feature. This want of variety does not apply to Diatomaceæ, which forms 87·5 p.c. of all the vegetable organisms. He notes the extraordinary size attained by *Draparnaldia*, which surpasses its ordinary length by 2–3 times. *Ulothrix zonata* is also widely spread, as well as *Tetraspora bullosa*, var. *cylindracea*. Species of Conjugatæ are very rare ; as also Phycochromaceæ, with the exception of *Microcystis olivacea*, which occurs in masses in certain parts of the lake at certain seasons. The author divides the area of Lake Baikal into four zones—the shore, the bottom, the open deep water, and the plankton, and treats of the characteristic forms of each. The flora of adjacent lakes, springs and rivers is described. The systematic portion of the paper includes records of 350 species, of which 200 are diatoms, a few being new.

Antarctic Algæ.†—A. and E. S. Gepp publish a list of the marine algæ brought home from the South Orkneys by the Scottish Antarctic Expedition. These represent 12 species, of which 4 are new, one being the type of a new genus (*Leptosarca*). A second species of that genus is *Halosaccion dumontioides* Harv., which has hitherto only been recorded from the far north. A new species of *Lessonia* is described, with laminæ 1–8 metres long. Some of the algæ here described were brought back by the British Antarctic Expedition, among them being a new species of *Phyllophora*, not found by the 'Scotia.'

Acrochætium and Chantransia.‡—Ed. Bornet begins by pointing out that *Chantransia corymbifera* Thuret, described in the 'Liste des Algues Marines de Cherbourg' of Le Jolis (p. 107), really includes two different species. One is epiphytic on *Ceramium rubrum*, and the other grows as a semi-endophyte on *Helminthocladia*. The latter is the true *Chantransia corymbifera*, while to the former is now given the name of *C. efflorescens* var. *Thuretii*. Both are figured. The remainder of the paper is devoted to an analysis of the genera *Chantransia* and *Acrochætium*. The author considers that both names should be retained as genera : *Achrochætium* to designate those species which are reproduced by monospores only ; *Chantransia*, for those species which have also sexual reproductive organs. A table is given of the sections into which both genera may be divided, with the species contained in each ; and references to specimens published in all the principal exsiccata are appended to the species-names.

* Bull. Soc. Imp. Nat. Moscow, ii. and iii. (1904) pp. 229–65 (1 pl.).
† Journ. of Bot., xliii. (1905) pp. 105–9 (1 pl.).
‡ Bull. Soc. Bot. France, li. (1904) pp. xiv.–xxiii. (1 pl.).

A New Genus of Squamariaceæ.*—F. Heydrich describes a new genus of this Order, *Polystrata*, which contains one species, *P. dura*, with the forms *nigra* and *fusca*. It grows on corals and pieces of calcified matter in the Tami Islands, German New Guinea. The thallus spreads like a crust over the substratum. It is formed of from 2–30 horizontal layers, composed of several individual plants, attached in the centre by a few short rhizoids. Tetraspores are described, but the cystocarps and antheridia are still unknown. It differs from already known genera in the peculiar form of attachment, the covering of the old thallus by new growth, and the unequally divided tetrasporangia. Its nearest ally is *Cruoriella*.

Dunaliella, a New Genus of Polyblepharideæ.†—E. C. Teodoresco has made a special study of *Chlamydomonas Dunalii* Cohn, and finds it sufficiently unlike *Chlamydomonas* as to form a new genus, *Dunaliella*. He describes in detail the form of the zoospores, and the manner in which it changed during certain experiments. The structure is then described, the dimensions, the mode of division, and the sexual reproduction. It is noted that *Dunaliella* exhales a most agreeable odour of violets. A full diagnosis is given of the new genus, of which the salient points are: cells possessing slightly metabolic properties; envelope containing no cellulose, elastic and accommodating itself to the changing form of the contents; two long flagella; multiplication by longitudinal division into two individuals. The author removes this genus from Chlamydomonadeæ to Polyblepharideæ, placing it beside *Polyblepharides*, *Pyramimonas* and *Chloraster*, as representing a type with two flagella.

Cladophoraceæ.‡—F. Brand gives an account of his studies on the mode of attachment of Cladophoraceæ, and describes several Polynesian forms of the family. As regards the rhizoids of *Cladophora* and other genera, he finds that they are more fully developed in marine than in fresh-water species. Direct attachment by means of unaltered vegetative cells occurs in *C. basiramosa* Schmidle only. The author treats also of the fibulæ of *Valonia*, *Boodlea*, etc. Several new varieties and forms of existing species are described, as well as the new species *Pithophora macrospora*, *Cladophora senta*, *C. Tildenii*, and *Boodlea Rænania*. *Cladophora composita* Hook. et Harv. is removed to *Boodlea*.

Plankton Investigation Round Iceland.§—O. Paulsen has made a study of the Plankton-associations and their relations to each other and to the currents. The material on which the investigation was founded was collected from the Danish Government steamer and an Icelandic mail steamer. To the south of Iceland *Asterionella* plankton prevails in early summer, and *Longipes* plankton in late summer and autumn. The boundary line of plankton associations off the south-east coast of Iceland is very marked, and the areas of these associations are shown on

* Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 30–6.
† Beih. Bot. Centralbl., xviii. (1905) p. 215–32 (2 pls.).
‡ Tom. cit., pp. 165–93 (2 pls.).
§ Meddel. Komm. for Havundersögelser. Plankton, i. (Copenhagen, 1904) pp. 1–41 (11 figs., 2 maps).

maps. The presence of whaling stations does not seem to diminish the quantity nor change the quality of the plankton. Five new species are described in the systematic part of the paper.

Studies on Cyanophyceæ.*—F. E. Fritsch gives the result of his studies on the structure of the investment and spore-development in some Cyanophyceæ. He finds that each cell of the sporogenous filament of an *Anabæna* has two envelopes, and when cell-division takes place the outer envelope is split into two by an intercellular septum. The The nature of the two envelopes is described in detail. The exospore and endospore of the spore are merely the outer cell-sheath and inner investment respectively, both of which, in the mature condition, completely envelop the protoplast. In *Oscillaria*, the transverse septa are less developed than in *Anabæna*, and the cell-sheath, instead of splitting during division, forms a coherent whole round the entire filament. The sheath of *Oscillaria* and that of *Lyngbya*, are entirely different structures, the former being a coherent cell-sheath, while the latter is homologous with the external mucilage of *Anabæna*. In *Tolypothrix* and *Rivularia*, the actual filament is provided with a cell-sheath, which is only in part coherent, and shows a very marked moniliform structure. The intercellular protoplasmic connections of many observers are due to changes produced in the gelatinous transverse portion of the inner investment during staining. Under the heading of "General Conclusions," the author discusses the mode of development of filamentous from unicellular forms.

BRAND, F.—**Ueber Spaltkörper und Konkavzellen der Cyanophyceen.** (On so-called fission-bodies and concave cells in Cyanophyceæ.)
Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 62–70.

CLERICI, E.—**Sopra una trivellazione eseguita presso Roma sulla via Casilina.** (On a boring effected near Rome in Via Casilina.)
[In a depth of from 31·50 and 34 metres from the surface diatoms were found, which included 36 species.]
Atti Real. Accad. Linc., xiv. (1905) pp. 224–8.

DIPPEL, L.—**Diatomeen der Rhein-Mainebene.** (Diatoms of the basin of the Rhine and Main.) Braunschweig (Vieweg) 1905, 170 pp., 372 col. figs.

FOSLIE, M.—**Algologiske Notiser.** (Algological notes.)
[On the systematic position of certain genera and species of Lithothamnioneæ. Two new species and a new variety are described.]
Kgl. Norske Vidensk. Selsk. Skrift. Trondhjem, 1904, pp. 1–9.
„ „ **Two new Lithothamnia.** *Op. cit.*, 1903, pp. 1–4.

GEPP, A. & E. S.—**Atlantic Algæ of the 'Scotia.'**
[A list of 13 species collected by Rudmose Brown off the coast of Brazil, at St. Paul Rocks, and St. Vincent, Cape de Verde.]
Journ. Bot., xliii. (1905) pp. 109–10.
„ „ **Rhipidosiphon.**
[A note on the distribution of this plant, now known as *Udotea javensis*. It has hitherto only been found in the Eastern tropics, but is here recorded as having been found by K. Yendo in the province of Hiuga, Japan.]
Tom. cit., p. 129

* Beih. Bot. Centralbl., xviii. (1905) pp. 1[illegible]–214 (1 pl.).

HIERONYMUS, G.—**Bemerkungen über Chlamydomyxa labyrinthuloides Archer und Chlamydomyxa montana Lankester.** (Remarks on *C. labyrinthuloides* Archer and *C. montana* Lankester.)
[Criticisms on papers by E. Penard in *Arkiv f. Protistenkunde*, iv. (1904) pp. 296–334, and by E. Ray Lankester in *Q.J.M.S.*, xxxix. (1897) pp. 233–243.] *Hedwigia*, xliv. (1905) pp. 137–57.

KEISSLER, K. VON—**Mitteilungen über das Plankton des Ossiachersees in Kärnten.** (Notes on the plankton of Lake Ossiach in Carinthia.)
[List of the species collected in the spring and summer of 1904.] *Oester. Bot. Zeitschr.*, lv. (1905) pp. 101–6.

KRAEMER, H.—**The Copper Treatment of Water.**
[An account of the method of G. T. Moore for the destruction of algæ and pathogenic organisms in water supplies.] *American Journ. Pharm.*, lxxvi. (1904) 574–9.

MANGIN, L.—**La Cryptogamie.** (Cryptogamy.)
[Opening lecture at the Paris Museum of Natural History. A short historical account of cryptogamic work during last century—algæ, etc.] Extr. from *Revue Scientif.* (Dec. 1904) 36 pp.

MIGULA, W.—**Thomé's Flora von Deutschland, Oesterreich, und der Schweiz. VI. Kryptogamen.** (Thomé's Flora of Germany, Austria, and Switzerland. VI. Cryptogams.)
[Algæ—continued.] Gera: Zezschwitz, 1904–5, lief 19–21, pp. 17–112 (14 pls.).

MUELLER, O.—**Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten.** (Bacillariaceæ from Nyassaland and some neighbouring regions. Distribution tables are appended.)
[Continuation.] *Engler's Bot. Jahrb.*, xxxvi. (1905) pp. 137–205 (2 pls.).

PASCHER, A.—**Kleine Beiträge zur Kenntniss unserer Süsswasseralgen.** (Small contributions to a knowledge of our fresh-water algæ.)
[Treats of the conditions of reproduction of *Draparnandia glomerata*.] *SB. Naturw.-med. Verein. Wien, "Lotos,"* 1904, 5 pp.

PRAIN, D.—**The Vegetation of the Districts of Hughli-Howrah and the 24-Pergunnahs.**
[Annotated list, containing 84 fresh-water and marine algæ, including 10 Florideæ, 4 Diatoms, and 7 Characeæ.] *Records Bot. Survey of India*, iii. (1905) pp. 143–339.

SIMMONS, H. G.—**Den färöiska hafsalgflorans slägtskapsförhållanden.** (An account of the affinities of the marine flora of the Faeröes.) *Bot. Notiser*, 1904, pp. 199–236.

WEISS, F. E.—**Seaweeds.**
[A popular lecture on the main groups of algæ, their colouring matter, reproduction, and economic uses.] *Proc. Manchester Field Club*, I. ii. (1905) pp. 142–4.

YENDO, K.—**Investigations on "Isoyake" (decrease of sea-weed).** *Journ. Imp. Fisheries Bureau Japan*, xii. (1903) pp. 1–33.

" " **"Isoyake" in the Prefecture of Chiba.** *Tom. cit.*, pp. 34–8.

" " **Relation between the Current and the Distribution of the Marine Vegetation of Tokyo Bay.** *Tom. cit.*, pp. 39–47.
[The above three papers are in Japanese, and refer to the decrease of seaweeds caused, as the author believes, by a sudden increase of river water owing to imprudent felling of forest trees.]

ZACHARIAS, O.—**Beobachtungen über das Leuchtvermögen von Ceratium tripos.** (Observations on the light capacity of *C. tripos*.) *Biol. Centralbl.*, xxv. (1905) pp. 20–30.

" " **Ueber eine Wasserblüte von Volvox minor und Volvox globator.** (On a water-bloom of *V. minor* and *V. globator*.) *Tom. cit.*, pp. 95–6.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Biology of Saprolegnieæ.*—Gaston Bonnier made artificial cultures of *Saprolegnia Thureti* in a solution of glucose with a slight addition of citric acid. When grown anaerobically in an atmosphere of hydrogen, all development ceased. In aerobic conditions it grew vigorously, and produced a somewhat complex fermentation. He found, also, that the fungus could live in a medium containing a mere trace of mineral substances.

Development of Ascomycetes.†—In following out the development of *Boudiera*, P. Clausen describes first of all his methods of culture, the appearance of *Boudiera* at different stages, and the reagents used by him to fix and stain the fungus so as to obtain the best results. He grew the fungus from the spore stage to the ripe fruit on agar with dung solution. No conidial form was produced. At an early stage of growth, short thick lateral branches are formed on the main hyphæ, which immediately branch again somewhat irregularly. From the same filament, or from one near, arise other branches which wind round those already described. The first formed branch becomes 3-celled—the upper cell is the trichogyne, the one immediately below is the ascogonium. An opening is now visible between the trichogyne and the winding filament, or antheridium, and from the ascogonium the asci begin to grow out. A blunt outgrowth is first formed, which bends over like a crook; the tip and base are cut off, and the central cell—the upper cell of the bend—forms the ascus. A large nucleus, or sometimes two nuclei, are visible at this stage in the ascus cell. The number of asci arising from one ascogonium could not be accurately determined: there are probably four or five. No difference in development or appearance could be distinguished between the hyphæ forming the outer wall of the fruit and those forming the paraphyses; the latter are septate, and each cell encloses several small nuclei, similar to those of the mycelial cells.

The author then proceeds to a more detailed description of the cells and their contents. These are multinucleate from the beginning; the fertile branches are also multinucleate. The ascogonium contains five to six nuclei; there were fewer in the end cell, the trichogyne, and these degenerate at the time when fusion takes place between the trichogyne and the antheridium. No opening was seen between trichogyne and ascogonium, but the nuclei of the latter increase to double the number, no nuclei being left in the antheridium, and the author concludes that the antheridial nuclei have passed over to the ascogonium. The nuclei in the ascogonium then fuse in pairs, the resulting nuclei being distinctly larger. When the ascogenous hyphæ grow out from the ascogonium they are at first bi-nucleate, then after bending over the basal and terminal cells are both seen to contain one nucleus only, the central cell—the young ascus—is bi-nucleate. These two nuclei ultimately fuse, and the uninucleate stage of the ascus persists for some time

* Comptes Rendus, cxl. (1905) pp. 454–5.
† Bot. Zeit., lxiii. (1905) pp. 1–28 (3 pls.).

before spore formation begins. The ascus elongates, the plasma is vacuolate in the upper and lower portions; it is homogeneous in the middle, and within it lies the nucleus, which is at first globose, then slightly drawn out parallel with the longer axis of the ascus. When division begins, the spindle is formed within the nuclear membrane. At the poles, darker bodies appear, but whether within or without the nuclear membrane was not quite clear. A small beak or polar radiation was distinctly visible after the third division of the nuclei. The radiating fibrils bend over and enclose the nucleus, forming the very thin first-formed spore membrane which for a time remains open opposite the beaked end. Finally it closes up and increases in thickness, and the characteristic marks begin to form on the *Boudiera* spores. The mature spore nucleus contains a nucleolus and finely granular chromatin.

The author reviews all the work hitherto done on the same subject, and discusses the facts for and against the sexual theory. His own observations lead him to believe in the existence of sexuality in at least some of the Ascomycetes. He classifies them in two groups: (1) those where one ascogonium gives rise to the whole fruit, as in *Dipodascus*, *Gymnoascus*, *Sphærotheca*, *Erysiphe*, and *Monascus*; (2) those where several ascogonia take part in the fruit formation, as in *Pyronema* and *Boudiera*.

Development of Monascus.*—H. P. Kuyper presents his work on *Monascus* in three chapters. In the first, he describes the researches on *Monascus* by Barker and Ikeno. In the second he gives the results observed by himself both on *M. purpureus* and *M. Barkeri*; and finally he masses together the work and views of the various students of sexuality in the Ascomycetes, and gives the general conclusions at which he has himself arrived. He sums up as follows: (*a*) The perithecial development of *Monascus purpureus* and *M. Barkeri* begins with the formation of pollinodium and ascogonium which are in open communication with each other. (*b*) In the ascogonium of both species, nuclear fusion takes place: in *M. purpureus* in free cells which are formed within the ascogonium; in *M. Barkeri* before or during the formation of the free cells. (*c*) The single nucleus of the free cells, which has resulted from the copulation of two nuclei, divides in *M. purpureus* into a large number of very small nuclei; in *M. Barkeri* there occur only three successive divisions into eight nuclei. (*d*) In the free cells the spores are formed; in *M. purpureus* there is no constant number, usually six to eight, sometimes one or two, in one observed case there were sixteen; in *M. Barkeri* eight spores were constantly formed. Each spore contains at first one nucleus, which subsequently divides, and the mature spore is multinucleate. (*e*) In the free cells there are remains of epiplasm during spore-formation. (*f*) The free cells disappear. The spores lie against the wall of the ascogonium. Between the spores lies a substance that does not stain in the same way as the spores do.

Kuyper concludes from these observations that *Monascus* is an Ascomycete of a new order Endascineæ in which the ascus is developed inside the ascogonium. He states further that though the Ascomycetes

* Ann. Mycol., iii. (1905) pp. 32–81 (1 pl.).

may be derived from forms possessing pollinodium and ascogonium, yet in place of fusion between the nuclei of these two organs there is now fusion between two ascogonial nuclei. This fusion takes place in *Monascus* in the ascogonium; in *Pyronema confluens* and some species of *Ascobolus* it takes place in hyphæ which arise from the ascogonium. In most of the Ascomycetes the distinction between pollinodium and ascogonium is partly or entirely lost, and nuclear fusion takes place in the ends of the ascogenous hyphæ.

White Mildew of Euonymus.*—*Euonymus japonica* is one of the commonest evergreens of Italian gardens. V. Peglion describes the attack of the mildew *Oidium*, which destroys the leaves. As the systematic position of this conidial form is somewhat doubtful, the author names it *O. Euonymi-japonicæ*. He found a species of *Cicinnobolus* parasitic on the mould. The fungus winters in the tissues of the *Euonymus*, and grows in spring with the new vegetation.

Erysiphaceæ.†—E. S. Salmon records results obtained in his cultural experiments with *Erysiphe* on *Euonymus japonicus*. The same plant has been frequently infested by a similar parasite in Japan, and it seems probable that the fungus has been introduced here from that country, though in the absence of perithecia it has been found impossible to identify it with absolute certainty. It has been proved by experiment not to be identical with the *Erysiphe* on *Euonymus europæus*. The leaves of *E. radicans* and some of its varieties, were the only other species of host plants that were susceptible to the fungus. All other species inoculated proved to be immune.

In another paper,‡ the author adds *Erysiphe taurica*, conidial stage, to the number of Erysiphaceæ that have been found to be parasites or hemiparasites. The mycelium of the fungus is endophytic; it branches freely in the intercellular spaces of the host tissue, and may invest the mesophyll cells closely. The conidiophores pass out through the stomata, and bear the chains of conidia on the surface of the leaf.

Aspergillus.§—C. Wehrner has studied this genus in its morphological, physiological, and systematic aspects. He finds 20 species in Germany and Switzerland, which he classifies in three groups, according to the colour of the young conidia—green, dark brown, or yellow. There are also two white species—*A. candidus* and *A. albus*.

North American Ustilagineæ.‖—G. P. Clinton has written a monograph of the fungi of this natural order that occur in North America. Of the 24 genera recorded, 19 have been found in America, and are described by the author. He describes nine new species, and gives a key to genera and species.

* Atti Reale Accad. Lincei, cccii. (1905) pp. 232–4.
† Ann. Mycol., iii. (1905) pp. 1–15 (1 pl.). ‡ Tom. cit., pp. 82–3.
§ Mem. Soc. Phys. Hist. Nat. Genève, xxxiii. No. 4 (1904) 157 pp. (5 pls.). See also Ann. Mycol. iii. (1905) pp. 117–18.
‖ Proc. Boston Soc. Nat. Hist., xxxi., No. 9 (1904) pp. 329–529. See also Hedwigia, xlvi. (1905) p. 61.

The Genus Phragmidium.* — P. Dietel has been occupied in determining the distribution and identity of species of *Phragmidium*, especially of those recorded from America. Only three forms have been found in the Southern Hemisphere; 25 forms are reported from America. Dietel describes these, and adds four to the North American flora. He notes many peculiarities of distribution, as, for instance, the Australian *Ph. Barnardi*, which grows on *Rubus parvifolius*, and of which the spores germinate at once on the same host. This same type of fungus has been found in Japan, also on *Rubus parvifolius*, and differing only in the number of cells. Dietel considers it to be a variety of the same species. He discusses the probable methods of transport of the spores. Many American forms supposed to be identical with those of Europe, have been found, on more careful examination, to be distinct species.

Notes on Uredineæ.† — Luigi Mentemartini found the *Oncidium* plants in Padua attacked by a *Uredo*; he watched its growth for a year, but only uredospores were produced. The sori occupied both sides of the leaf. He noted that the plant-cells immediately adjoining the fungus retained their green colour longer than the rest of the leaf. The new species is called *Uredo aurantiaca*.

M. A. Carleton‡ has investigated the rusts of a number of plants in order to arrive at more definite knowledge of their life-histories. *Uromyces Euphorbiæ* produced all the different stages on the one host-plant. *Puccinia Helianthi* is peculiar to some of the species of the genus *Helianthus*; the Æcidium is of rare occurrence, the *Uredo* form often growing from a teleutosporic infection. The crown rust of oats was found to form its Æcidium on *Rhamnus lanceolata*. Among other results he notes that it is possible for a perennial rust to exist in an annual host, the mycelium being carried over in the seed of the plant. "Such an instance is practically certain in the *Euphorbia* rust."

W. Tranzschel § has established several new cases of heterœcism in rusts. *Æcidium Trientalis*, he finds, is identical with *Puccinia Karelica*, on *Carex*; *Æcidium coruscans* with *Chrysomyxa Ledi*, the teleutospores inducing a witch's broom on *Ledum*. He has also identified *Ochrospora Sorbi* with *Æcidium leucospermum*.

In another paper ‖ he points out how the morphological form may aid in determining the biological relationship. Thus he finds that the teleutospores of *Puccinia Amphibii* agree exactly with those of *Puccinia Morthieri*, which inhabits *Geranium silvaticum*. He therefore looks for its Æcidium on the *G. silvaticum*, and finds *Æcidium sanguinolentum* the related form. The teleutospores of *Uromyces Rumicis* and those of *Uromyces Ficariæ* are identical, and he finds the Æcidium of the forms also on *Ranunculus Ficaria*. Several other similar instances are given of this rule of identity.

* Hedwigia, xliv. (1905) pp. 112–32 (1 pl.).
† Atti Ist. Bot. Pavia, viii. (1904) pp. 99–101 (1 pl.).
‡ U.S. Dept. Agric., Bull. 63 (1904) 29 pp. (2 pls.).
§ Travaux du Musée bot. Acad. Imp. Sci. St. Petersburg, ii. (1904) 17 pp.
‖ Arb. K. St. Petersburg Natur. Gesell., xxxv. (1904) 13 pp. See also Bot. Zeit., lxiii. (1905) pp. 75–6.

Tranzschel * adds several other cases of heterœcism that he has more recently established; that *Puccinia Polygoni* belongs to an Æcidium on *Geranium pusillum*; *Uromyces Veratri* is connected with *Æ. Adenostylis*; *Uromyces Rumicis* with *Æ. Ficariæ*, etc.

Theophil Wurth † has completed a study of the Pucciniæ on Rubiaceæ. He finds that several distinct species exist instead of only one. He gives an account of his experiments to establish his facts, and describes each species in detail. He also found on *Galium Mollugo* an Æcidium that had no connection with the *Puccinia*. It evidently belonged to a heterœcious species. Infection experiments have so far failed to determine the alternative host.

Oscar Mayus ‡ has made a comparative study of the peridial cells of certain *Æcidia* that grow in different localities. Where the conditions of habitat, temperature, etc., are the same, there is no distinguishable difference between one plant and another. In cases where the cell-wall is thicker or thinner, the influence of nutrition accounts for the variation.

Swiss Uredineæ.§—Ed. Fischer has published that part of the Swiss flora dealing with plant rusts, the classification followed being that of Dietel in Engler and Prantl's *Pflanzenfamilien*. The earliest mention of Uredineæ in Switzerland occurs in Albrecht von Haller's "Historia stirpium Helvetiæ," published in 1768. Since then many have taken part in collecting and studying these fungi, and Fischer gives a short account of the different workers. He discusses the distribution with reference to position and climate, the period of time during which Uredineæ have been present in Switzerland, and the appearance of stranger forms, such as *Puccinia malvacearum*. He explains his method of grouping the different species, and gives the lines on which he differentiates species morphological and biological. Full descriptions of genera and species are given; in many cases spores, etc., are figured. Bibliography and host-index are added, as also the source of the materials used in compiling the monograph.

Amphispores of Grass and Sedge Rusts.‖—J. C. Arthur gives an account of amphispores, first described by Carleton in 1901. They are modified uredospores possessing thick indurated walls and semi-persistent pedicels. They have been found mostly in the semi-arid regions of America. One species is recorded from the Himalayas. They have been often confounded with the teleutospores of *Uromyces*, but they differ from those in possessing two or more germ-pores, while teleutospores have only one. They also share with uredospores the power of infecting the plant on which they have grown. Teleutospores infect only the alternate host. Their advantage to the fungus lies in their capacity to withstand adverse conditions for a considerable time; they are really

* Arb. bot. Mus. K. Akad. Wiss. St. Petersburg, 1904, pp 14–30. See also Ann. Mycol., iii. (1904) p. 107.

† Centralbl. Bakt., xiv. (1905) pp. 209–24, 309–20 (14 figs.).

‡ Dissert. (1904) 33 pp. See also Bot. Centralbl., xcviii. (1905) p. 340.

§ Beiträge zur Krypt.-Flora der Schweiz, Bd. ii. Heft ii., Berr. K. J. Wyss., 1904, xciv. and 590 pp., 342 figs.

‖ Bull. Torrey Bot. Club, xxxii. (1905) pp. 35–41 (9 figs.).

resting uredospores. Arthur describes a number of species that possess amphispores, nine species in all.

Potato Diseases.*—F. M. Rolfs has made a careful study of a disease of potatoes caused by *Corticium vagum* var. *solani*. He has established the connection of this fungus with *Rhizoctonia*, of which it is the fruiting form. There are, therefore, three stages of the disease, the *Rhizoctonia*, the sclerotial, and the *Corticium*. The latter usually occurs at the edge of a diseased portion next the living tissues. It bears basidia and spores. *Rhizoctonia* is a mycelial stage.

Diseases of Trees.†—O. Appel has investigated a disease of Red Alder trees. He found dead branches beset with the fruits of *Valsa oxystoma*. Infection experiments with *Valsa* spores failed to reproduce the fungus, and the author concludes that the damage is due to several factors, such as frost, failure of water, etc., which render the young trees peculiarly liable to attack from fungi. Other observers have detected several other fungi causing the same disease, *Cytospora*, *Melanconium* and *Cryptospora*, which attack dry twigs and enter the tissues through wounds. A change of trees is recommended, as also altering the conditions of moisture by draining, etc.

A. Möller ‡ reports that *Trametes Pini* causes loss to German foresters yearly of some 1,000,000 marks. He has examined the manner of propagation, and insists on the effort to stamp it out. Pines are safe until the heart-wood is formed, because only in the heart-wood does the fungus develop, infection taking place by a broken branch, and always by means of spores. The spores may be formed during the whole year, but in most abundance from September to January. The mycelium does not live saprophytically. Möller recommends breaking off the fruiting bodies and brushing the base with a preparation of lime. It does not kill the fungus, but it greatly retards spore-production.

H. C. Schellenberg § writes on the occurrence of *Hypodermella Laricis*. It attacks the leaves of the lower branches of the Larch more vigorously than those higher on the tree, causing them to turn brown. It does not cause great damage.

Adolf Aeslar ‖ gives his views on the cause of Larch disease. The fungus *Peziza Willkommii* is not a pure parasite; it attacks through wounds or in weakened conditions of the host-plant.

Plant Diseases in India during 1903.¶—E. J. Butler, Cryptogamic Botanist to the Government of India, records the chief cases of disease that came under his notice. He gives a very short account of the parasite and the host-plant. The most destructive on tea was, he found,

* Colorado Agric. Exp. Stat. Bull., xci. (1904) pp. 1–33 (5 pls.). See also Bot. Centralbl., xcviii. (1905) pp. 255–6.

† Naturwiss. Zeitschr. Land. Forstw., ii. (1904) pp. 313–20. See also Ann. Mycol., iii. (1905) p. 111.

‡ Zeitschr. Forst. und Jagdw., xxxvi. (1904) pp. 677–715 (2 pls.). See also Bot. Centralbl., xcviii. (1905) pp. 147–8.

§ Naturwiss. Zeitschr. Land. Forstw., ii. (1904) pp. 330–7. See also Ann. Mycol., iii. (1905) p. 115.

‖ Centralbl. Ges. Forstw. (1904) 27 pp. See also Ann. Mycol., iii. (1905) pp. 111–12.

¶ Zeitschr. Pflanzenkr., xv. (1905) pp. 44–8.

an alga which kills the twigs or forms a lichen which is equally fatal to the leaves. A large number of fungi are recorded on grasses and cereals. Potatoes, tomatoes, sugar-cane, and palms have all suffered from various parasitic fungi. *Cedrus Deodora* was destroyed by *Polyporus annosus*. *Acacia arabica* was killed by *Fomes Passianus*, not hitherto considered a parasite. *Trichosporium*, *Peridermium* and *Uredo* have also attacked various trees.

Plant Diseases during the Year 1903.*—M. Hollrung has just issued the "Jahresbericht," dealing with diseases of plants caused by animals, plants, or unfavourable conditions. He treats the latter first, as general injury due to temperature, light and shade, poisons, wounds, crowding, etc. The larger part of the volume is occupied by an account of special cases of disease, first of the agents causing disease, and secondly of the different plants that have been recorded as attacked during the year.

A chapter is devoted to plant hygiene, and the conditions that are most favourable to the healthy development of plants in enabling them to withstand the attacks of fungi, insects, etc. The author finally deals with various remedies, the encouragement of certain fungi that prey on insects, or of birds that devour insects, which are included under "organic" remedies. The inorganic remedies are the chemical compounds, applied as sprays, etc., which have been found to destroy the pests without injuring the host-plant. The editor gives, in this work, the results of 2207 original papers, the bibliography of which is published after each section to which they relate.

Diseases of Cultivated Plants.†—M. C. Cooke has collated the different fungus pests of the ornamental shrubbery. He describes a large number, mostly leaf diseases, so that they may be recognised by the gardener. In many cases he advises as to the remedies to be used. In another contribution ‡ he describes the disease called Apple and Pear Scab, due to the fungus *Fusicladium pirinium* and *F. dendriticum*. These diseases have been very destructive in Tasmania.

E. S. Salmon § gives an account of the American Gooseberry Mildew, of which the first recorded appearance was in Ireland in 1900. It has spread to a number of localities; since that date it has been found in various parts of Russia, and more recently in Denmark. Besides the use of fungicides, Salmon recommends burning the affected parts.

Geo. Massie ‖ writes on some diseases of the Potato. He describes the havoc wrought by *Phytophthora*, *Nectria*, *Ædomyces* and *Sorosporium*. He also describes a disease due to Bacteria, which has been very destructive in America, and which has occurred once or twice in this country.

Plant Diseases.—G. Lustner¶ has examined a large number of leaves of the vine affected by the "red brand." He has failed to find the fungus *Pseudopeziza*, and thinks the disease must be due to some other

* Jahresber. Pflanzenkr., vi. (1903), Paul Parey (Berlin, 1905) viii. and 374 pp.
† Journ. Roy. Hort. Soc., xxix. (1904) pp. 1–25 (3 col. pls.).
‡ Tom. cit., pp. 91–2. § Tom. cit. pp. 102–10.
‖ Tom. cit., pp. 139–45 (6 figs.).
¶ Ber. K. Lehr. für Wein. Obst. Garten. zu Geisen. a Rh. für das Etatsjahr 1903, pp. 190–1. See also Centralbl. Bakt. xiv. (1905) pp. 147–8.

cause. He has also watched* the development of the sclerotia of *Monilia fructigena* on apples till they have attained a considerable size. He compares them with those described by Woronin.

In another communication† he gives his views on the occurrence of *Peronospora viticola*, which usually makes its appearance in July, while most other fungi of that genus develop in March, April, and May. He considers that the decaying leaves in the tissues of which the fungus is imbedded are dug into the ground and rot there. Then at the second period of cultivation, in June–July, the ground is turned over, and the diseased leaves are again exposed, and infection follows—due to wind or other agencies conveying the spores. These facts should form a guide as to the best time for spraying the vines.

Heinrich Uzel‡ recounts the diseases of plants in Bohemia during 1904. Chief among these he reckons *Puccinia glumarum*, which in some districts destroyed half the crops. Pear trees suffered from *Venturia pirinum*. Apples were cankered by *Nectria ditissima*. These and other fungi did great damage to cultivated plants. The author also gives cases of insect attack.

K. Posch§ writes on the mischief caused to Cucurbitaceæ by the fungus *Pseudo-peronospora cubensis*. It has been specially hurtful to Melons.

Diseases of Beet.‖—L. Hiltner and L. Peters have conducted various experiments having for aim the prevention of disease in the sugar-beet. Infection experiments with *Phoma Betæ* and *Bacillus mycoides* were without result, and they concluded that these organisms only attacked roots that were weakened by the presence of oxalates. These were produced in the plant by stormy weather and other adverse conditions. The authors recommend the use of lime to combat the disease, as it has been found more effective than sulphuric acid.

F. Krüger¶ has examined another disease of beets, a formation of cork causing scabs on the roots. It is due, he finds, to the presence of both animal and fungal organisms. Several species of *Oospora* were found infesting the beets, but they were wound parasites, and entered the tissues after they had been attacked by Nematodes, etc. The author recommends drainage and lime as preventive measures.

French Mycology.—M. Boudier** describes four new species of the larger fungi, found in peat-moss. He thinks that such soil is rich in fungi and has not been properly worked.

P. Vuillemin†† describes a new species of Pyrenomycete, *Seuratia pinicola*. He thinks the genus distinctive enough to be placed in a new

* Ber. K. Lehr, für Wein. Obst. Garten. zu Geisen, a Rh. für das Etatsjahr 1903, pp. 188–90. † Tom. cit., pp. 187–8.

‡ Wiener Landw. Zeit., 1904, p. 917. See also Centralbl. Bakt., xiv. (1905), pp. 152–3.

§ Zeitschr. "Kert," 1904, No. 244 (2 figs.). (Magyar.) See also Bot. Centralbl., xcviii. (1905) p. 255.

‖ Arb. Biol. Abt. Land. und Forstw. K. Gesundh., iv. (1904) p. 207 (253). See also Ann. Mycol., iii. (1905) pp. 108–9.

¶ Tom. cit., pp. 253–318. See also Ann. Mycol., iii. (1905) pp. 109–10.

** Bull. Soc. Mycol. France, xxi. (1905) pp. 69–73 (1 pl.).

†† Tom. cit., pp. 74–80 (1 pl.).

family, the Seuratiaceæ. Instead of a perithecium, the asci are protected by a mucilaginous coating composed of the swollen ends of the hyphæ, forming a brown granular layer. The spores are colourless.

N. Patouillard* has received a fungus from Tonkin, which he has determined to be a new genus *Rollandina* (Gymnoasceæ). It is stalked something like an *Onygena*, but the outer covering of the fruit is loose and filamentous. The spores are minute and colourless.

A. Maublanc † examined some apples covered with rather large light-coloured spots, which were dotted with small black tubercles. He found that they were caused by a fungus which he names and describes as *Trichoseptoria fructigena*. The mycelium penetrates deeply into the fruit between the cells, which become dissociated and brown.

F. Guéguen ‡ has reviewed the species of *Dictyosporium* and *Speira*. He finds that these two genera are alike, the former name being retained. He considers the fruit to be an aggregation of conidia, the terminal member of each filament possessing, usually, germinating power alone. He describes the germination and development of the fungi in artificial culture.

W. Harlay § describes cases of poisoning due to *Amanita phalloides*. He is anxious to get details of all such cases.

Trehalose in Fungi.‖—This enzyme, which acts on trehalose as do invertase or sucrase on saccharose, has been already detected in several fungi. Em. Bourquelot and H. Herissey have examined a further number of plants, and they find that the results vary considerably, according to the age and condition of the fungus at the time of examination, but they have proved that the enzyme is generally present in fungus tissues, and indispensable for the utilisation of trehalose, a substance that corresponds to the saccharose of the higher plants.

Effect of Turgesence in Fungi.¶—F. Guéguen records an instance of a fungus, *Agaricus campestris*, that raised an asphalte walk to a height of several centimetres over a diameter of 30 centimetres. The mushroom was split across the top and the stalk was distorted by the pressure, but the gills had formed almost normally and had produced an abundance of spores.

New Parasitic Fungi.**—C. A. J. A. Oudemans describes a *Leptostroma* that was living on the needles of *Pinus austriaca*. *Sclerotiopsis pityophila* (Sphæropsideæ) he found on the needles of *Pinus silvestris*, and on the withered leaf-sheaths of *Typha latifolia* there occurred a hitherto insufficiently described member of the Tuberculariaceæ, *Hymenopsis Typhæ*.

Edible and Poisonous Fungi.††—The economic aspect of fungi has been studied by G. F. Atkinson. He gives popular descriptions of a

* Bull. Soc. Mycol. France, xxi. (1905) pp. 81–3 (1 pl.).

† Tom. cit., pp. 95–7 (1 fig.).

‡ Tom. cit., pp. 98–106 (2 pls.).

§ Tom. cit., pp. 107–10.

‖ Tom. cit., pp. 50–7.

¶ Tom. cit., pp. 39–41.

** Kon. Akad. Wetensch. Amsterdam, vii. (1904) pp. 206–13 (3 pls.). See also Hedwigia, xliv. (1905) p. 62.

†† Studies of American Fungi: Mushrooms, Edible, Poisonous, etc. Henry Holt and Co. (New York, 1903) v. and 323 pp., 230 photos., and col. pls.

great number of the larger fungi, with special reference to their edible or poisonous qualities. He devotes one chapter to the cultivation of mushrooms. A number of recipes for cooking them are given by Sarah Tyson Rores. The Chemistry and Toxicology of Mushrooms is added by J. F. Clark. The results of Atkinson's analyses correspond with those arrived at by European chemists, and all prove that the fungi are much less nourishing than they were at one time supposed to be. The poisons found in fungi are also described. The author adds a key for the determination of the genera.

Immunity from the Poison of Fungi.*—René Ferry has experimented with the poison of *Amenita phalloides* on rabbits, in order to discover a cure for the cases of poisoning that occur through eating this fungus. He found that iodide of potassium was not so effective as it was supposed to be. He then tried immunising animals by repeated doses, and he not only rendered these animals immune, but the serum had the effect of rendering other rabbits immune. It had, however, no effect as a curative agent, and the author considers that such a serum may be neglected, considering the comparatively few cases of poisoning that occur.

Abnormalities in Fungi.†—J. Lutz describes some cases in which supernumerary hymeniums are formed in the larger fungi. A certain number of cases, he considers, are explained by the close contact and attachment of two fungi at an early stage of growth; the more vigorous plant pushes ahead and hoists the less developed individual with it, sometimes carrying it reversed on the pileus or attached to the edge.

Technical Mycology.‡—Franz Lafar has published a further instalment of his Handbook of Technical Mycology for technical and agricultural chemists, brewers, etc. Part III. is a continuation of part I., and concludes the work of Lindau on Eumycetes. The author describes the anatomy and physiology of fungoid hyphæ and cells, and discusses reproductions in fungi entirely from Brefeld's standpoint, that no sexuality exists among the higher fungi, agreeing thus with Dangeard. He regards the *Mucor* sporangium and the ascus as closely related.

Hugo Fischer-Bonn gives the chemistry of fungi and bacteria, both of cell-membrane and of contents. The subjects of assimilation and metabolism are dealt with by W. Benecke. Alfred Koch, L. Hiltner, P. Miquel, M. Hahn, A. Spickermann, S. Winogradsky, and H. Jensen tell what is known of the various processes of nitrification and nitrogen assimilation, the action of acids, etc. Cladotricheæ, Streptotricheæ, etc., are described by W. Rullman.

ARTHUR, J. C.—**Bæodromus Holwayi Arth., a new Uredineous Fungus from Mexico.**
[The teleutospores of the new genus *Bæodromus* are catenulate. The germination resembles that of *Coleosporium*.]
Ann. Mycol., iii. (1905) pp. 18–20.

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* Rév. Mycol., xxvii. (1905) pp. 1–4.

† Bull. Soc. Mycol. France, xxi. (1905) pp. 47–9 (3 figs.).

‡ Handbuch der technischen Mykologie, G. Fischer, Jena. Part II, 112 pp., 2 pls. and 18 figs.; part III, 160 pp., 41 figs.; part IV, 112 pp., 4 pls. and 5 figs. See also Bot. Zeit., lviii. (1905) Art. ii, pp. 56–8.

Behrens, J.—Mehltau der Quitte. (Mildew of the Quince.)
[The fungus was found to be a species of *Sphærotheca*, which had passed to the Quince from another host.]
Ber. Grossherzogl. badisch. landwirtsch. Versuchsanst. Augustenburg uber Tätigkeit im Jahre 1903, pp. 39-40.
See also *Centralbl. Bakt.*, xiv. (1905) p. 145.

" " **Krankheitserscheinungen am Flieder.** (Disease of the Alder.)
[*Phoma depressa* was found in abundance on the dead twigs.]
Tom. cit., pp. 42–3.
See also *Centralbl. Bakt.*, xiv. (1905) p. 148.

" " **Einflus auserer Verhaltnisse auf die Ueberwinterung parasitischer Pilze.** (Influence of external conditions on the wintering of parasitic fungi.)
[The writer thinks that a mild winter is more unfavourable than a severe one to the life of the fungus, as other influences come into play which are hurtful.]
Tom. cit., pp. 28–30.
See also *Centralbl. Bakt.*, xiv. (1905) p. 146.

" " **Beobachtungen über Brandkrankheiten.** (Observations on rust diseases.] *Tom. cit.*, pp. 40–1.
See also *Centralbl. Bakt.*, xiv. (1905) p. 146.

" " **Untersuchungen über die Schwankungen bei Keimkraftprüfüngen und ihre Ursachen.** (Researches on variation in germination, and the causes of it.)
[The writer passes in review a number of cases of germinating seeds. He finds that the germinating power is destroyed by the attacks of small fungi.]
Tom. cit., pp. 43–8. See also *Centralbl. Bakt.* xiv. (1905) p. 146.

" " **Das Teigigwerden der Mispeln.** (The over-ripeness of Medlars.)
[Behrens finds that this condition is induced by various moulds—*Mucor*, *Monilia*, and *Botrytis*.]
Tom. cit., pp. 38–9.
See also *Centralbl. Bakt.*, xiv. (1905) pp. 146–7.

" " **Der rote Brenner der Ruben.** (The red brand of the vine.)
[The perfect fruits of the fungus *Pseudopeziza tracheiphila* were found on the diseased leaves.]
Tom. cit., pp. 36–7.
See also *Centralbl. Bakt.*, xiv. (1905) p. 147.

Busse, W.—Reisebericht der pflanzenpathologischen Expedition des kolonialwirtschaftlichen Komitees nach Westafrika. (Travelling report of the plant-pathological expedition of the Colonial Committee for West Africa.)
[The report deals with diseases caused by fungi and by animals.]
Der Tropenpflanzer, No. 1 (1905).
See also *Centralbl. Bakt.*, xiv. (1905) pp. 235–6.

" " **Untersuchungen über die Krankheiten der Sorghum-Hirse Ein Beitrag zur Pathologie und Biologie tropischer Kulturgewächse.** (Researches on the diseases of Millet. A contribution to the pathology and biology of tropical cultivated plants.)
[The writer discusses the various insect pests, etc., also the species of *Ustilago* that attack Millet plants.]
Arb. biol. Abt. Land. Forstw. Kais. Ges., iv. (1904) p. 319–426 (2 pls.).
See also *Centralbl. Bakt.*, xiv. (1905) pp. 141–5.

COPELAND, E. BINGHAM—**Fungi esculentes Philippinenses.** (Edible fungi of the Philippines.)
[One puff-ball and a large number of Agaricineæ are described, all new to science.]
Ann. Mycol., iii. (1905) pp. 25–9.

DIETEL, P.—**Uredineæ Japonicæ. V.**
[A number of new species are included in the list.]
Engler's Bot. Jahrb., xxxiv. (1904) pp. 583–92.

GILLOT, X.—**Empoisonnement par les Champignons.** (Poisoning by fungi.)
[The author notes the increase of illness due to the eating of poisonous fungi. He strongly urges education by pictures, etc., in all schools, especially in the country.]
Bull. Soc. Mycol. France, xxi. (1905) pp. 58–63.

GILLOT, X., & N. PATOUILLARD—**Contribution à l'histoire naturelle de la Tunisie. Notes botaniques et mycologiques.** (Contribution to the natural history of Tunis. Botanical and mycological notes.)
[A number of new species of fungi are recorded by N. Patouillard.]
Bull. Soc. Hist. Nat. Autun, xvii. (1904) 42 pp., 5 pls.
See also *Bot. Centralbl.*, xcviii. (1905) p. 144.

HARZ, C. O.—**Oospora cretacea sp. n.** (Diagnosis of the new species, and comparison with related forms.)
Bot. Centralbl., Orig., xviii. (1905) pp. 113–14.

HALGAND, FELIX—**Étude sur les trichophyties de la barbe.** (Study of Trichophyton of the beard.) *Arch. de Parasitol.*, viii. (1904) pp. 509–622 (4 figs.).
See also *Bot. Centralbl.*, xcviii. (1905) p. 279.

HENNINGS, P.—**Einige schädliche parasitische Pilze auf exotischen Orchideen unserer Gewächshäuser.** (Some harmful parasitic fungi on the exotic Orchidaceæ of our hot-houses.)
[The fungi described, all of which are new, belong to the Uredinaceæ, Pyrenomycetes, Sphæropsidaceæ, Nectroideaceæ, Excipulaceæ, Melanconiaceæ, Stilbaceæ, and Tuberculariaceæ.]
Hedwigia, xliv. (1905) pp. 168–78.

„ „ **Fungi amazonici. IV. A cl Ernesto Ule collecti.** (Fungi from the Amazon collected by Ernest Ule.)
[Many new species are described by the author. The new genera are *Phæosacardinula* (Microthyriaceæ) and *Phragmographum* (Hysteriaceæ).
Tom. cit., pp. 57–61 (3 figs.).

HOLWAY, E. W. D.—**North American Uredineæ.**
[The paper contains descriptions of a number of new species.]
Ann. Mycol., iii. (1905) pp. 20–4.

HORNE, W. T.—**A New Species of Lembosia.**
[The fungus was parasitic on stems of *Vanilla planifolia*.
Bull. Torrey Bot. Club, xxxii. (1905) pp. 69–71.

IDETA, ARATA—**Lehrbuch der Pflanzenkrankheiten im Japan. Ein handbuch fur Land. und Forstwirte, Gartner, und Botaniker.** (Text-book of plant diseases in Japan. A handbook for landowners, foresters, gardeners, and botanists.)
Shokwabo (Tokio, 1903) 8vo, 144 text figs. and 13 pls., 2 col.
See also *Zeitschr. Pflanzenkr.*, xv. (1905) pp. 54–5.

JAAP, O.—**Erster Beitrag zur Pilzflora der Umgegend von Putlitz.** (First contribution to the fungus flora of Putlitz.)
Verhandl. Bot. Ver. Prov. Brandenburg, xlvi. (1904) pp. 122–41.
See also *Bot. Centralbl.*, xcviii. (1905) pp. 32–3.

KUSANO, S.—**Einige neue Taphrina-Arten aus Japan.** (Some new species of *Taphrina* from Japan.)
[Three new species are described.]
Ann. Mycol., iii. (1905) pp. 30–1.

LAURENCE, W. H.—**The Apple-scab in Western Washington.**

[This disease is caused by a species of *Venturia*; the conidial or summer form belongs to the genus *Fusicladium*.]

Bull. Washington Agric. Expt. Station, lxiv. (1904) pp. 1–24.
See also *Bot. Centralbl.*, xcviii. (1905) pp. 201–2.

MCALPINE, D.—**Nature or Blackfellows' Bread.**

[A description of the sporophores of *Polyporous mylittæ*, the underground sclerotium of which is eaten by the natives.]

Journ. Depart. Agric. Victoria, ii. (1904) pp. 1012–20 (4 figs.).
See also *Bot. Centralbl.*, xcviii. (1905) p. 228.

MAGNAGHI, ANGELO—**Contribuzione allo studio della Micologia Ligustica.** (Contribution to the study of the Mycology of Liguria.)

[The writer deals only with microfungi; there are several new species described.] *Atti Ist. Bot. Pavia*, viii. (1904) pp. 121–33.

MAGNUS, PAUL—**Ein kleiner Beitrag zur Kenntnis der parasitären Pilze von Mitterfels in Niederbayern.** (A small contribution to the knowledge of parasitic fungi in Mitterfels, Niederbayern.)

[23 species of parasitic fungi are described.]

17 *Ber. Naturwiss. Ver. Land. uber die Vereinsjahre* 1900–3, Landshut, 1904, pp. 1–3.
See also *Hedwigia*, xliv. (1905) p. 62.

MAGNIN, L.—**La Cryptogamie.** (Cryptogamy.)

[A short historical sketch of Cryptogamic Botany, including Fungi, Lichens, etc.]

Extr. from *Rév. Scientif.*, Dec. 1904, 36 pp.

MASSEE, G.—**Discovery of the Fruit of the Apple Mildew in England.**

[The fungus is *Sphærotheca Mali*; the perfect fruit is now recorded for Britain.] *Gardener's Chronicle*, xxxvi. (1904) p. 349.

MAUBLANC, A.—**Espèces nouvelles de Champignons inférieurs.** (New species of the lower fungi.)

[The species, mostly parasites, infested various leaves and twigs.]

Bull. Soc. Mycol. France, xxi. (1905) pp. 87–94 (2 pls.).

MÜLLER-THURGAU, H.—**Nachweis von Saccharomyces ellipsoideus im Wembergsboden.** (Proof of the existence of *Saccharomyces ellipsoideus* in the ground of vineyards.) *Centralbl. Bakt.*, xiv. (1905) pp. 296–7.

MURRELL, W. A.—**The Polyporaceæ of North America. X. Agaricus, Lenzites, Cerrena, and Favolus.** *Bull. Torrey Bot. Club*, xxxii. (1905) pp. 83–103.

OFFNER, JULES—**Les Spores des Champignons au point de vue Médico-légal.** (The spores of fungi from a medico-legal point of view.)

[A study of spores that may help to distinguish poisonous from harmless forms.] Allier (Grenoble, 1904) 67 pp. (2 pls.) 8vo.
See also *Bot. Centralbl.*, xcviii. (1905) p. 228.

PATOUILLARD, N., & P. HARIOT—**Fungorum novorum decas prima.** (First decade of new fungi.) *Bull. Soc. Mycol. France*, xxi. (1905) pp. 84–6.

PECK, C. H.—**New Species of Fungi.**

[Twelve species of the larger fungi are described.]

Bull. Torrey Bot. Club, xxxii. (1905) pp. 77–81.

POIRAULT, J.—**Liste des Champignons supérieurs observés jusqu'à ce jour dans la Vienne.** (List of fungi observed in Vienne.)

[The author describes 63 species of Hymenomycetes.]

Bull. Acad. intern. Géog. Bot., No. 180 *bis* (1904) pp. 362–8.
See also *Bot. Centralbl.*, xcviii. (1905) p. 228.

RICK, J.—**Fungos do Rio Grande do Sul (Brazil).** (Fungi from the Rio Grande.)

[The author describes a number of new species, and gives notes and observations on those already known. *Laschia tremellosa* he finds is identical with *Auricularia Auricula-judæ*.

Broteria, iii. (1904) pp. 276–93.
See also *Hedwigia*, xliv. (1905) p. 63.

RICK, J.—**Fungi austro-americani, Fasc. ii.**
[The author lists 21 species; several of them are new and are fully described.] *Ann. Mycol.*, iii. (1905) pp. 15–18.

ROLLAND, L.—**Champignons des îles Baleares récoltés principalement dans la region montagneuse de Sóller.** (Fungi of the Balearic Islands, collected chiefly in the mountainous region of Sóller.)
[A number of new species are recorded; 310 plants are included in the list.] *Bull. Soc. Mycol. France*, xxi. (1905) pp. 21–38 (2 pls.).

STUDER, B.—**Die Pilzsaison von 1904 im der umgegend von Bern.** (The fungus season of 1904 in the neighbourhood of Berne.)
[Prolonged drought followed by heavy storms produced abnormal developments both of species and individuals.]
Schw. Woch. für Chemie und Pharmacie, No. 44, 1904, 8vo, 2 pp.
See also *Bot. Centralbl.*, xcviii. (1905) p. 280.

SUMSTINE, D. R.—**The Boletaceæ of Pennsylvania.**
Torreya, iv. (1904) pp. 184–5.
See also *Bot. Centralbl.*, xcviii. (1905) p. 280.

SZABO, ZOLTAN VON—**Ueber eine neue Hyphomyceten-Gattung.** (A new genus of Hyphomycetes.)
[The new genus is called *Tetracoccosporium* (Dematiaceæ). It grew on dung in the laboratory. Spores and fertile hyphæ are brown, the sterile mycelium is colourless.] *Hedwigia*, xliv. (1905) pp. 76–7 (1 fig.).

TROTTER, A.—**Ascochyta Salicorniæ P. Magnus var. Salicorniæ patulæ Trotter.**
[Two species have been recently described under the same name; the latter is not identical, but is a variety of the former.]
Ann. Mycol. iii. (1905) p. 30.

WILL, H.—**Vergleichende Untersuchungen an vier Untergarigen Arten von Bierhefen.** (Comparative researches on four species of fermenting beer yeasts.)
[A description of the behaviour of the different yeasts in artificial cultures.]
Centralbl. Bakt., xiv. (1905) pp. 129–135.

WURTH, TH. — **Beiträge zur Kenntnis der Pilzflora Graubündens.** (Contribution to the knowledge of the fungus flora of Graubundens.)
[Notes are given on many of the species.]
Jahresb. Naturforsch. ges. Graubundens, neue Folge, Bd. 46 (1904) pp. 19–28.
See also *Hedwigia*, xliv. (1905) p. 64.

Lichens.

Theory of Endosaprophytism in Lichens.* — This subject is thoroughly discussed by A. Elenkin. He gives an historical review of the whole question of the relationship between algæ and fungi in the lichen thallus, and states that as yet the theory of mutabilism or symbiosis remains an hypothesis. The parasitic action of the fungus haustoria on the algal cells has been more or less proved in comparatively few cases. He quotes the conclusions arrived at by Warming, that the algæ are passive agents, and give to the fungus more than they receive: they are "helots" rather than symbionts.

The author then gives the results of his own research. He finds in all lichens more or fewer dead algal cells that outnumber the living. A few of these can be accounted for as being the empty cells after division and escape of the daughter cells, and some have died probably from the absence of light and air. The large bulk have been destroyed

* Bull. Soc. Imp. Natural. Moscou, 1904, Nos. 2 and 3 (1905) pp. 164–86.

by the fungus. He gives the general name of nekral layer to these dead cells; they are most numerous where the hyphæ are strongest. The empty cells are deposited in the medulla and gradually absorbed by the hyphæ. Elenkin describes the methods he employed to stain and determine the different layers of gonidia, and then he describes the examination of a large number of species, all tending to strengthen his theory of endosaprophytism, and this theory he considers sufficient to explain the relation between algæ and fungi in lichens. A descriptive list of papers on this subject is added.

New Lichen Type.*—G. Briosi and R. Farneti describe a plant that grew on the stems of the vine, resembling *Pionnotes Biasolettiana*. A thorough examination showed that the mycelial elements were mixed with algal cells, thus placing the plant among the lichens. On the surface of the lichen they found the *Pionnotes* conidia, fusiform septate bodies. In addition there were imbedded in the thallus perithecia with asci. The writers examine and meet the various objections that could be offered to this solution of the problem; they find that it is not formed of the union of two fungi, and that the plant is not a fungus saprophytic on a lichen or other fungus. The lichen is gelatinous in texture and homoiomerous, and falls under the division Pyrenocarpi. The authors place it in a new family Chrysoglutenaceæ, with the name *Chrysogluten Biasolettianum*.

How to Collect and Study Lichens.†—Bruce Fink advises the student as to the method of beginning the study of lichens. The outfit necessary for collecting is described, and the places most likely to yield good specimens. Further advice is given as to the microscopic study, and the pressing and drying of the plants for the herbarium. The writer recommends envelopes for holding the specimens and brown paper mounts for the larger forms.

Notes on Lichens.‡—Max Britzelmayer gives a description of *Sagedia augustana*, a lichen that grows on calcareous sandy soil; he has found it a second time. The same author publishes § the description and figures of the plants of the "Lichenes exsiccati aus der Flora von Augsburg," which was issued during 1902 and 1903. The lichens are carefully described, and notes on the different species are given. The figures represent the natural appearance of the plants, spores, etc., and are magnified and their colour indicated.

HESSE, O.—**Ueber einige Orseilleflechten und deren Chromogene.** (On some Orchill-Lichens and their Chromogene.) *Ber. Chem. Ges.* xxxvii. pp. 4693–6.

LEDERER, M.—**Die Flechtenflora der Umgebung von Amberg.** (The Lichen Flora of the neighbourhood of Amberg.) *Amberg*, 1904, 8vo. 48 pp. See also *Ann. Mycol.* iii. (1905) p. 121.

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* Atti Ist. Bot. Pavia, viii. (1904) pp. 103–19 (2 pls.).
† Bryologist, viii. (1905) pp. 22–7.
‡ 36 Ber. Naturwiss. Schwaben und Neuburg a V., 1904, pp. 127–8.
§ Tom. cit., pp. 23–89 (30 pls.) See also Hedwigia, xliv. (1905) pp. 64–5.

Picquenard, C. A.—**Lichens du Finistère.** (Lichens of Finistère.)
[The author gives notes on the influence of climate, etc., on distribution; there is one new species recorded, *Biatora erysibetta.*]
Bull. Acad. intern. Geogr. Bot. xiii. (1904) pp. 1-48, 108-32.
See also *Ann. Mycol.* iii. (1905) p. 121.

Stamatin, M.—**Contribution à la flore Lichenologique de la Roumanie.** (Contribution to the Lichen Flora of Roumania.) *Ann. Sci. Univ. Jassy,* 1904, 17 pp.
See also *Ann. Mycol.* iii. (1905) p. 121.

Zopf, W.—**Zur Kenntnis der Flechtenstoffe.** (Knowledge of Lichen substances.)
Justus Liebig's Ann. Chemie, cccxxxviii. pp. 35-71.

Mycetozoa.

Lister, A. & G.—**Mycetozoa from New Zealand.**
[The specimens, including one new to science, were collected by Miss Hibbert-Ware. Graphic notes of the localities are given with descriptions and lists of the species.] *Journ. Bot.* xliii. (1905) pp. 111-14.

Schizophyta.

Schizomycetes.

Bacillus hypothermos, a Micro-organism Pathogenic for Cold-blooded Animals.*—C. Scharz isolated this organism from a lizard, *Hatteria punctata.* The animal had died, and the autopsy showed abscess cavities about the sternum, filled with caseating contents resembling tuberculous deposit; microscopic examination of this caseous matter showed a large number of small rods 1 μ–1·4 μ long, which from their small size and their frequent arrangement in pairs, gave the impression of diplococci; they stained by the ordinary dyes, but were decolorised by Gram's method; when freshly obtained and stained with Loeffler's blue, they showed deep polar stainings. They were actively motile, having numerous long peritrichal flagella. Spore formation was never observed. The optimum temperature was between 15° and 20° C. The bacillus grew readily on ordinary media, under both aerobic and anaerobic conditions, a slight alkalinity of the medium apparently enhancing the vigour of its growth. Its peptonising action on gelatin was very much diminished under anaerobic conditions. After 20 hours on a gelatin plate it formed round, scarcely visible, membranous, superficial colonies, at first resembling those of *B. typhosus*; later these became brown in the centre with clear transparent margins, and floated in the cup of liquefaction; on agar plate after a few hours, it formed small, round, membranous, finely granular colonies, the centres coloured brown, fading away to the periphery; the deep colonies being round or whetstone shaped with smooth margins of a yellow-brown colour; cultures in broth and in pepton water became, after a few hours, uniformly clouded, and a pellicle was never formed; milk was firmly coagulated after 48 hours, but no acid was produced; on blood serum there was abundant growth and rapid liquefaction. The growth on potato was very remarkable; whereas the earlier growth appeared as a quite uncharacteristic yellowish-white membrane. After five or six days small

* Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) p. 11.

bubble-like outgrowths appeared on the surface, and these slowly grew to large gas-containing bladders, which later ruptured. Indol reaction was observed in pepton water cultures after three days, and gas formation occurred in glucose broth after two days; a strong reducing action was manifested by the addition of methylen-blue to the media; the production of H_2S was never observed. It showed no pathogenicity for warm-blooded animals, but Tritons, Lizards, Salamanders, and Tortoises were found to be very susceptible, dying after three to four days; the susceptibility of frogs was variable, being greater in March and April than in the summer months.

Distribution of the Microbes in the Intestines of Infants.*— H. Tissier finds that the bacteriological aspect of the meconium period before the definite milk stools have become established, comprises three phases: (1) an aseptic phase when the digestive tract is sterile, the first bacteria commencing to appear only about the tenth to twentieth hour; (2) "phase d'infection croissante" commencing with the first appearance of microbes before any attempt at alimentation has occurred, and lasting to the middle of the third day; it is preceded by a discharge of epithelial cells from the mouth accompanied by cocci (*Staphylococcus albus*), soon followed by a cocco-bacillus not staining by Gram (*B. coli*), large rods (*B. perfringens*), slender rods (*B. III. Rodella*), diplococco-bacilli not staining by Gram's method (*B. perfoetens*, *B. lactis aerog.*), diplococci staining by Gram's method and sarcinæ, and later *B. mesentericus*, *B. acidophilus* and *B. bifidus*; (3) "phase de transformation," which lasts 12 to 24 hours, during which the flora become simplified, the microbes gradually disappearing in a fairly constant order, until by the fourth day, when the meconium period has ended and the milk stool has become established, the flora of the intestine is constituted by one species only, *B. bifidus*; and in the breast-fed child this aspect will be maintained until it is weaned; it is usual to find besides this strictly anaerobic bacillus, a limited number of facultative anaerobes (*B. coli communis*, *Enterococcus*, and *B. lactis aerogenes*). In the case of the bottle-fed child, the second phase of the meconium period is longer, and yeasts and varieties of sarcinæ are met with that are rare or unknown in the stools of the breast-fed infant; the third phase also is prolonged, even to the fifteenth day after birth; the bacteria are very various, varying in the same child from one stool to another.

The microbes of the meconium period were found to provide mixed proteolytic and peptolytic ferments, which as the result of their action on sugars and albuminoids, give rise to a process identical with putrefaction. The microbes of the meconium are the same in animals as in children, but the microbes of the milk stools are slightly different.

The microbes forming the intestinal flora of the infant can be isolated from all parts of the digestive canal, but they are not distributed equally in every part. They are less numerous in the stomach, become very rare in the duodenum and in the first portion of the small gut, then they progressively increase, attaining a maximum in the cæcum and rectum. Passing from the stomach to the rectum, the microbes

* Ann. Inst. Pasteur, xix. (1905) p. 109.

predominate in the following order, *B. coli*, *B. lactis aerogenes*, *Enterococcus*, *B. exilis*, *B. acidophilus*, and *B. bifidus*; that is, in the order of their sensibility to oxygen, and according to the strength of their fermentation. The distribution of microbes in the intestine is the result of three causes: (*a*) the sterilising action of the secretion of the duodenum; (*b*) the greater or less degree of oxygenation of the region; and (*c*) the greater or less ferment action of the bacteria.

Spirillum pyogenes Mezincescu.*—R. Doerr isolated after death from a case of cirrhosis of the liver, an organism which he regarded as similar if not identical with the spirillum of Mezincescu. From the purulent contents of the bile-ducts he prepared smears which showed only solitary non-Gram-staining rods, and which in culture resembled the *Bacillus coli communis*. Smear preparations from the pus of the pleural cavities and from the pericardium stained with warm dilute carbol-fuchsin showed numerous comma-like curved rods 1 μ long and very thin, two often attached sigma-like together, and frequently 4–6 individuals united into a spirillum; these forms were partly free and partly included in the leucocytes; they stained very badly with other stains, and were decolorised by Gram's method.

The author's original cultures having failed, he injected 2 c.cm. of the pus intraperitoneally into a white mouse. The animal died within 48 hours; in the peritoneal effusion he found great numbers of spirilla identical in form and staining reaction with those observed in the pus. Cultures were made from this peritoneal exudate on agar, blood agar, broth, ascitic broth, and glucose broth; after 48 hours the broth showed a faint cloudiness, which later increased, and after a week there was a greyish-white sediment at the bottom of the tube; similar cultures grew in ascitic broth and glucose broth, no gas being formed. No growth was obtained in pepton-salt solution, milk, on potato, glycerin-agar, glucose-agar, or gelatin; nor was there any growth under anaerobic conditions, nor at 22° C. It was not pathogenic for ordinary animals, the apparent exception in the case of the mouse being due to the large dose of the pus that was inoculated; a similar dose inoculated into a guinea-pig was without result. In spite of this he considers that this organism was the cause of the purulent pericarditis.

Micro-Organism causing an Epidemic Disease among Cats.†—N. Mori describes the clinical and pathological appearances found in a cat dying from an epidemic disease, which, during the summer of 1903, was attacking a number of cats in Sienna.

On agar cultivations made from the blood, the liver, and the spleen, he obtained pure cultures of an organism—a round-ended, motile bacillus with 6–8 long peritrichal flagella, staining by the ordinary dyes, but not by Gram nor Claudius; a potential anaerobe, with an optimum temperature between 30° and 37°; it was killed by exposure to 45° C. for 30 minutes or 50° C. for 5 minutes; it was very resistant to drying; spore formation was never observed. Grown in broth at 30°–37° C., after 6 hours a uniform clouding appeared, and later a pellicle formed

* Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) p. 15.
† Tom. cit., pp. 42 and 186.

which became thick and dry and sank to the bottom of the tube, a fresh pellicle being re-formed and the process repeated; the medium had an alkaline reaction, and possessed an unpleasant odour. On gelatin yellow disc-like colonies appeared within 48 hours; no liquefaction of the medium occurred. No indol reaction could be obtained, but a reduction of nitrates was demonstrated. With glucose, maltose, and mannite it produced acid and gas; with saccharose, lactose, and glycerin neither acid nor gas formation occurred; neutral red was completely decolorised within 24 hours. It was pathogenic to guinea-pigs, rabbits, pigeons, white mice, cats, and hedgehogs, and was obtained from the blood of these animals after death. The author describes the methods he adopted for immunising and for obtaining serum; from a rabbit, after a series of injections, he obtained a serum that agglutinated the bacilli in 30 minutes, with a 1–500 dilution; the bacillus was also clumped by anti-typhoid serum in dilutions of 1–30. He considers that the organism belongs to a new species, and he has named it *Bacillus caticida*.

Thermophilic Microflora of the Human Intestine.*—G. Bruini reports a number of bacteriological examinations of human fæces. From an adult he isolated 9 thermophilic micro-organisms, 7 varieties of bacilli, and 2 varieties of streptotricheæ; 4 bacilli and 1 streptothrix were absolute thermophils, all were essential aerobes, grew well on potato, stained by Gram's method, and showed spore formation; none were pathogenic. From the fæces of a new-born child he isolated 6 thermophilic micro-organisms, 3 varieties of bacilli and 3 varieties of streptotricheæ, only one of which agreed with any of those he had isolated from the fæces of the adult; they were all essential aerobes, and stained by Gram's method, and only one did not show spore formation; none were pathogenic. He gives details of the morphology and cultural characteristics of the micro-organisms he has isolated, and adds notes referring to the researches by other workers on the thermophilic bacilli and streptotricheæ occurring in nature.

Biology of the Cholera Spirillum.†—W. B. Wherry has made a study of the variations which occur in one culture of cholera spirillum, and compared it with cultures from different sources. He finds that the morphology of the different cultures does not markedly vary if precautions are taken to make preparations from corresponding portions of growths. His cultures were found to be specifically the same as shown by the Grüber-Durham and Pfeiffer reactions.

The cholera spirillum is not a nitrifying organism, and the successful demonstration of the cholera red reaction in a solution of Witte's pepton depends upon the presence of a trace of nitrates. He finds that the type of liquefaction produced in gelatin is influenced by the reaction and melting-point of the gelatin. Growth in the presence of carbohydrates showed that the acids produced from glucose, maltose, and saccharose rapidly kill the cholera spirillum, whilst those produced from lactose and starch are not toxic, at least, within a given time.

* Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) pp. 177 and 298.
† Bureau Gov. Lab. Manila, No. 19, Oct. 1904.

Streptothrix pseudo-tuberculosis.*—F. Sanfelice compares the morphology, cultural aspects, and pathogenic action of the various members of the *Streptothrix* group with the *Bacillus tuberculosis*; especially referring to their acid-fast properties and to the similar morbid anatomical changes produced, and to the analogous histogenetic characters of pseudo-tuberculosis and tuberculosis. He refers to a number of cases described by various authors, of *Streptothrix* infection occurring in man. He considers that a real distinction beween pseudo-tuberculosis and true pulmonary consumption can only be established after cultures of the organism have been obtained. His experiments on serum immunisation and serum therapy have as yet been unsuccessful.

Bacillus acidificans presamigenes casei.†—C. Gorini describes an organism which he has designated from its power of peptonising milk in the presence of lactic acid ferments, *B. acidificans presamigenes casei.* It is from 8–10 μ long and 2 μ broad. It is motile, spore-forming, potentially anaerobic, and Gram staining. It grows well in the usual media, and at ordinary temperature. It turns broth turbid, and forms a pellicle on the surface. On gelatin the colonies are white, liquefying, and round, with irregular contour.

Vibrio Cardii.‡—E. Klein confirms the statement of Hirschbruch and Schever, who found that the Drigalski-Conradi medium was useful for isolating vibrios. By its aid the author isolated from the Cockle, *Cardium edule*, a vibrio which liquefies gelatin, very much like *V. Choleræ*. The Cockle vibrio grows well in pepton-water and in broth. It does not form indol. Litmus milk is reddened, but the milk remains fluid for 8 days, coagulation only occurring later. *V. Cardii* is pathogenic to guinea-pigs.

Bacillus violaceus Manilæ.§—P. G. Woolley isolated an organism from three Carabaos which died suddenly but without noteworthy symptoms. This organism, designated *B. violaceus Manilæ*, is from 1-1·5 μ long by 0·5 μ broad. It stains easily, but not by Gram's method. It does not, however, stain uniformly, showing clear spaces somewhat resembling spores; it is motile, and possesses one polar flagellum. It grows well on the usual media, and forms a blue pigment which is soluble in alcohol, slightly soluble in water and ether, and insoluble in chlorofom. It liquefies gelatin, is an essential aerobe, its optimum temperature is 37° C., it is easily killed, and does not form spores. It is pathogenic to animals.

Bacillus jasmino-cyaneus and Bacillus flavo-aromaticus.‖—W. Gaehtgens reports on two chromogenic bacteria which were met with in typhoid stools. *B. jasmino-cyaneus* is an extremely motile rodlet, an essential aerobe, and non-Gram-staining. It grows well at 24° and 37° C. It does not form spores or acid. Colonies of gelatin are iridescent, the medium becoming liquefied and stained of a dark green hue. The

* Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) p. 30.
† Rendiconti R. Istit. Lombardo Sci. e Let., xxxvii. (1904) pp. 939-45.
‡ Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) pp. 173–4.
§ Johns Hopkins Hosp. Bull., xvi. (1905) pp. 89–93.
‖ Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) pp. 129–31.

agar colonies are also iridescent, the medium becoming of an emerald green colour. Milk is coagulated and peptonised. It forms indol, but no gas. It is pathogenic to small animals.

B. flavo-aromaticus is a medium-sized rodlet, of moderate motility, and strictly aerobic. It does not form spores or stain by Gram's method. It grows in rosette-shaped yellow colonies. It liquefies gelatin and serum. It coagulates and peptonises milk, imparting an alkaline reaction to the medium. All the colonies exhale a fruity odour.

Bacillus conjunctivitidis subtiliformis.*—J. Michelski isolated from numerous cases of conjunctivitis a bacillus which, from its resemblance to the hay bacillus, is designated *B. conjunctivitidis subtiliformis*. It is a motile rodlet, 2–2·5 μ long and about 0·5 μ thick. The ends are rounded. It stains easily, and is not decolorised by Gram's method. In old cultures the bacilli are ovate with central spores. The optimum temperature is 37° C., but there is copious growth at room temperature. It forms a thick, yellowish-brown surface scum on bouillon. Gelatin and blood-serum are liquefied. It grows well on most media. On potato it forms a moist brown overlay.

Formation of Volatile alkaloids by Bacillus nobilis.†—L. Adametz and T. Chszaszek report that prolonged cultivation (22 months) of *Bacillus nobilis* in milk yields a basic substance when distilled. This substance, termed tyrothrixin, also found in Emmenthal cheese, is white, crystalline, and readily soluble in ether, alcohol, or dilute acids, and volatile at ordinary temperatures.

FREUDENREICH, ED. VON.—**Ueber die Wirkung verschiendener Milchsäurefermente auf die Käsereifung.** (Effect of different lactic acid ferments on cheese ripening.) *Centralbl. Bakt.* 2te Abt., xiv. (1905) pp. 34–43 (1 pl.).

ADENEY, W. E.—**Chemical Changes attending the Aerobic Bacterial Fermentation of Simple Organic Substances. Part I. Urea, Asparagin, Albumose, Rochelle Salt.** *Proc. Roy. Irish Acad.*, xxv., section 13 (1905) pp. 6–24 (2 pls.).

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* Centralbl. Bakt., 1te Abt. Orig., xxxvi. (1904) pp. 212–14.

† Milchw. Zentr., 1905, i. 78–80. See Journ. Chem. Soc., lxxxvii. and lxxxviii., 1905, ii. p. 273.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Engineer's Metallurgical Microscope.†—This instrument (fig. 57) was designed by J. E. Stead, F.R.S., for use in engineering works, where large forgings require examination when in the lathe, or when laid on

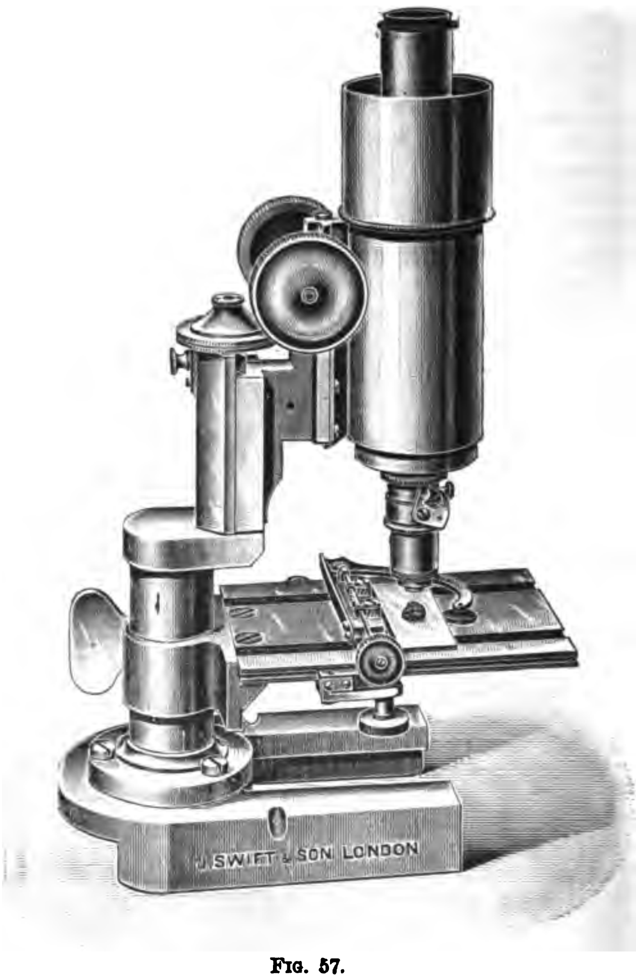

FIG. 57.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† J. Swift and Son's Catalogue, 1904, p. 35.

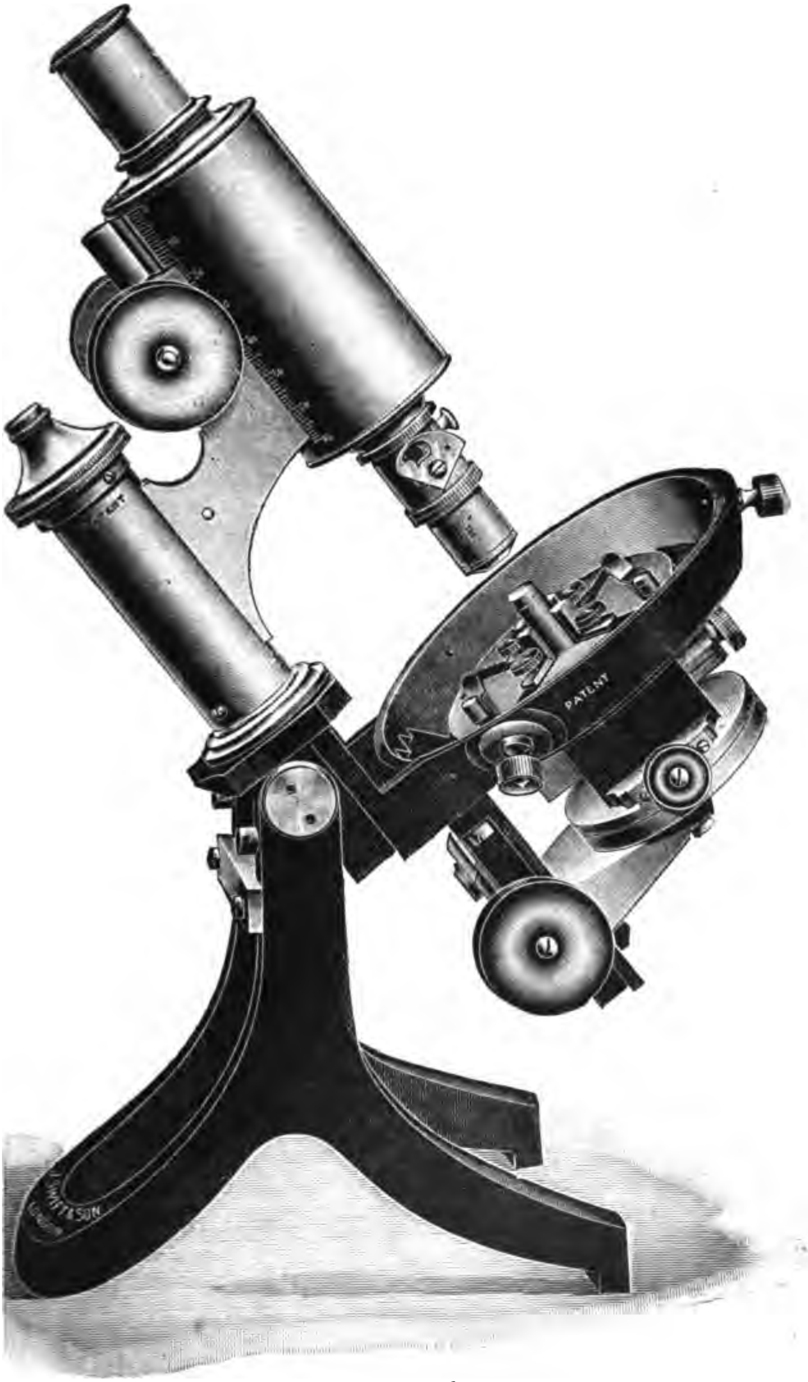

Fig. 58.

the ground. It is specially massive. A solid stage is made to swing round, so that the object-glasses can be brought into focus on the forging or casting upon which the foot or fork rests. To effect this, an inside tube carrying the object-glasses slides within the outer barrel and can be lowered to a sufficient distance. By means of a simple wire rope strap the stand is rigidly held in any required position on the piece of metal under examination. When in focus the position of the barrel is fixed by a screw at one side of the rack and pinion. When so fixed a ¼ plate conical camera may be placed on the top of the barrel and photographs taken.

Swift's New Compound Metallurgical Microscope.*—In this instrument (fig. 58), specially designed for the Royal Arsenal, Woolwich, the optical tube is 2¼ in. in diameter, and is divided to show the position at which any objective will allow of an object being tilted without going out of focus. The stage is so designed that after focussing the object in the horizontal position it may be tilted or turned in any direction without affecting the focussing. The ordinary slide is held on the top of the stage by means of steel springs, while pieces of metal are held in position by four clamping dogs sliding in dovetails and fixed by small clamping screws.

FIG. 59.

Reichert's Medium Dissecting Microscope.†—This instrument (fig. 59) has a rack and pinion adjustment, large stage, and a couple of leather-covered hand-rests. The doublet has a magnification of 10 times.

* J. Swift and Son's Catalogue, 1904, pp. 36–7.
† C. Reichert's Special Catalogue, No. 25 (1904) fig. 19.

Reichert's New Microscope for Brain Sections.*—This large model Microscope, shown in fig. 60, is made with an unusually large equip-

FIG. 60.

ment and with an extra-size stage, for the thorough exploration of such large objects as brain-sections, etc. The object-slides are moved by

* C. Reichert (Vienna) Catalogue No. 25 (Mikroskopie, 1904) p. 36, fig. 17*d*.

hand motion. The coarse adjustment is by rack and pinion; the fine by micrometer screw. The Microscope is fitted with the Abbe illuminating apparatus, hollow and plane mirrors.

Tafner's New Preparation Stand.*—This is made by G. Reichert, and is shown in fig. 61, about one-third full size. The arrangement will be easily understood from the illustration.

FIG. 61.

Imperial Standard Yard.†—A description of the Comparator, and the method of using it, would be outside the range of our work, but we may legitimately examine the micrometer Microscopes by which the measurements are made. These seem to be of a most elementary type, and as such wholly inadequate for the work in hand. The N.A. of the objectives is something under 0·1, their greatest separating power is therefore less than ·0001, so that $\frac{1}{10000}$ in. must be taken as the limit of the accuracy of this comparator. All refinements, such as an error of ·01° C. in a thermometer, or the compression of the rod due to a change in the barometric pressure, are meaningless when such elementary microscopical micrometers are employed. Apparently the whole of the apparatus was made abroad.

(2) Eye-pieces and Objectives.

Reichert's New Erect Image Preparation System for Preparation Microscopes.‡—This system of lenses, as applied to Reichert's Large Model Preparation Microscope, is shown in fig. 62. The arrangement of Porro prisms by which an erect image is obtained is seen in section.

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) p. 41, fig. 20a.
† Memorandum on the Construction and Verification of a new copy of the Imperial Standard Yard. Part I. London, 1905, 57 pp., 4 pls.
‡ C. Reichert (Vienna) Catalogue No. 25 (Mikroskopie, 1904) p. 40, fig. 20.

The Microscope itself is of large size, and is equally fit for the examination of brain sections or of small objects. It has a glass stage 10 cm. by 10 cm., which may be replaced by an accompanying metal plate. The base is a heavy horseshoe: the hand-rests are mahogany and of large size. The lens-carriers have both horizontal and vertical

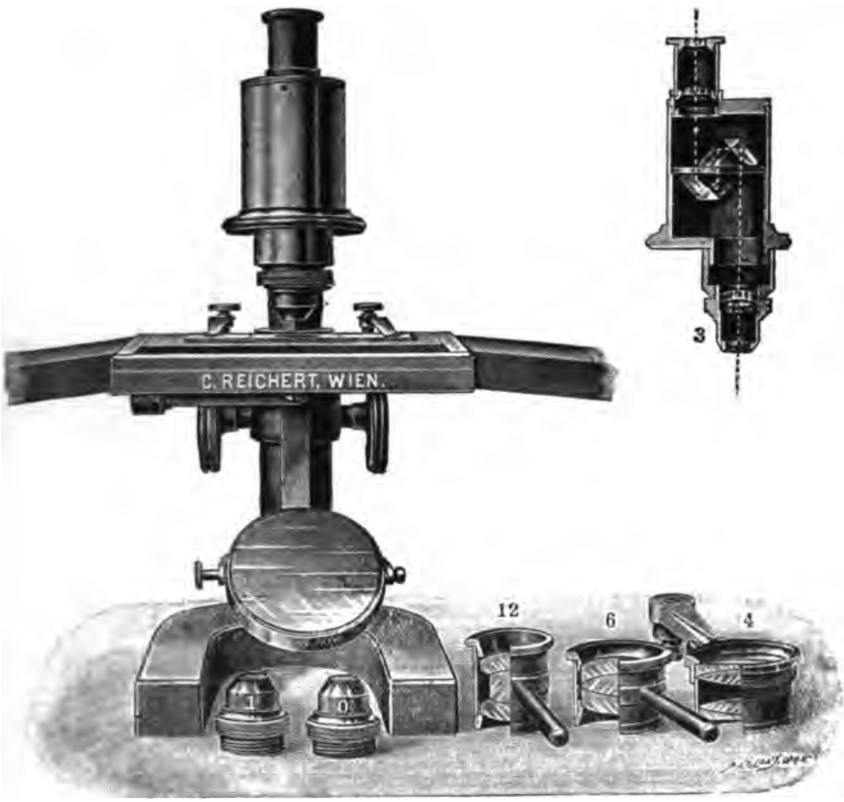

FIG. 62.

adjustments, and there is provision for a second carrier of weak magnification. There is a sub-stage arrangement for reducing the light at pleasure; the mirrors are plane and concave, and can be placed so as to illuminate from above.

New Method of using the Plankton Searcher.*—P. Mayer has found a simple means for obviating the difficulties attendant on the use of the Plankton Searcher.† These difficulties, more or less attendant on the great working distance, have been got over by means of a glass

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 447–9 (2 figs).
† See this Journal, 1898, pp. 677–8; 1899, pp. 111–12.

tube from 35–50 mm. long, and having an outside measurement of about 15 mm. (fig. 63) which is inserted for a distance of about 5 mm. into a piece of rubber tubing 20–25 mm. long, and just wide enough to grip the objective firmly. The parts are fitted together as follows:— Screw the objective on to the Microscope barrel, push up the tube, reverse the barrel, fill the tube slowly with water, put a cover-glass or piece of paper on the top, and then insert the barrel in the stand. As soon as the free end of the tube is immersed in the vessel, the cover-glass or paper falls off. By shifting the rubber tubing on the objective, the operator can adapt the apparatus to the height of the water in the vessel and the objects therein. A depth of 10 mm. is

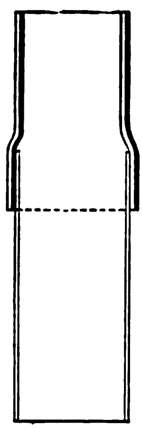

FIG. 63.

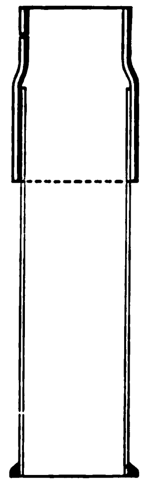

FIG. 64.

sufficient, but if the objects are thick, or at a distance from the bottom, more water is necessary.

If the operator prefers to work with a closed tube, the rubber tubing must have a small perforation (fig. 64) to allow water to escape when the objective is pushed down.

The cover-glass forming the bottom of the tube may be stuck on with marine glue or with Mendelejeff's cement. An advantage of this method is that the objective may be surrounded with distilled water. The cover-glass does not in any way interfere with the sharpness of the image.

Simple form of Index Ocular.*—G. C. van Walsem, after descanting on the usefulness of the index ocular for demonstration purposes, points out that a simple and effective index eye-piece can be made by merely

* Zeitschr. wiss. Mikrosk. xxi. (1904) pp. 174–7 (1 fig.).

drilling a hole in the ocular just above the diaphragm. The aperture should be of such size that it will admit the passage of a medium-sized pin (about 3 cm. long) to serve as indicator.

(3) Illuminating and other Apparatus.

Pfeiffer's Hot-Air Chamber.*—This apparatus, made by C. Reichert, is seen in fig. 65. It is intended for the heating of the whole Microscope. It is fitted with a thermometer and a gas thermo-regulator.

FIG. 65.

Reichert's New Achromatic Condenser.†—This illuminating apparatus has an aperture of 1·30, and as will be seen from the illustra-

* C. Reichert (Vienna) Catalogue No. 25 (Mikroskopie, 1904) p. 53, fig. 26*b*.
† C. Reichert's Catalogue, No. 25 (1904) p. 13.

tion (fig. 66) the iris diaphragm has a scale marked above the slit, a feature often of great convenience.

FIG. 66.

J. E. Stead's Illuminator for Opaque Objects.*—This is a simple and effective apparatus for illuminating metallurgical specimens by reflected light, but is only intended for use with low-power objectives, 1½–3 in. The illustration (fig. 67) sufficiently explains the principle of illumination. The metal box has one of its sides cut at an angle of 45°, this being faced with a small square of glass, the surface of which is illuminated by means of a lamp with or without the intervention of a bull's-eye condenser. The circular collar pushes on to the body of the objective.

FIG. 67.

SIEDENTOPF & SZIGMONDY's New Microscopic Apparatus for rendering visible Ultra-microscopic Particles in Glasses and Liquids.
[This apparatus is now made by C. Reichert.]
C. Reichert (Vienna) Special Circular.

(6) Miscellaneous.

High Power Microscopy.†—In an address at the Royal Institution J. W. Gordon observed that in the exhibition of a microscopic object under high magnifying power there are three stages in which difficulties have to be met and surmounted—(1) In the preparation of the object for exhibition under suitable conditions of illumination; (2) in the representation of the object by means of an image; (3) in the transmission of the image so found in the instrument to the eye of the observer. Professor Wright classified the preparation of objects into colour pictures by means of stains and outline pictures. The method of staining having manifest limitations, Mr. Gordon proceeded to refer to the use of cross-lighting or "dark-ground illumination" in order to show outlines, with especial reference to Dr. Siedentopf's application of this principle to the exhibition of so-called "ultra-microscopical particles."

* J. Swift and Son's Catalogue (1904) p. 35.
† Knowledge, ii. (1905) pp. 114–15.

In ruby glass, for instance, the colour is due to minute particles of gold diffused through the glass, so small as to be beyond the powers of the Microscope as ordinarily used. By special methods of illumination, however, at right angles with the optical axis of the Microscope, and by limiting the plane of such illumination, the particles come into view as diffraction discs. Mr. Gordon then dealt with some experiments of his own, originally suggested by a paper of Lord Rayleigh's, but which were still incomplete, which consisted especially of a method of lighting up the object by means of diffracted light, the principle being explained by a diffraction slit formed by the edges of two knives stuck in a board so that their edges overlapped towards the points, but were about an eighth of an inch apart near the handles. It was such a piece of apparatus that Sir Isaac Newton worked when he made his first precise recorded observations on the subject of diffracted light. Mr. Gordon referred to the observation of Helmholtz, as far back as 1874, that the limit of a useful power in a high-power objective is reached when the lens of the objective is of such focal length that its diameter is rather less than the diameter of the pupil of the eye, and that beyond that point there was no advantage in increasing the magnifying power of the objective, but that further magnification was best obtained by increasing the power of the eye-piece. But this method had also drawbacks owing to the smallness of the emergent pencil of light; such, for instance, as the greater prominence of dust upon the lens or of floating particles in the eye. Mr. Gordon considered that this was responsible for the limitation of magnifying powers at present in use by microscopists to 1500 or 2000 diameters, whilst most good work was done with magnifications of from 400 to 600—a statement, however, which surely needs some qualification, whatever may be the incidental disadvantages due to high eye-piecing. However, Mr. Gordon's method of getting over the difficulty is by the interposition in the tube of the Microscope of a ground-glass screen on which the image is received from the objective, so as to scatter the incident rays of light, the screen being made to oscillate in order to prevent its grain from becoming visible and so impairing the details of the picture. This picture can then be magnified again by means of a second Microscope in place of an ordinary eye-piece, with consequent greatly increased magnification. It may not perhaps be superfluous to recall that the mere magnification of an object, or even the rendering visible of what could not otherwise be seen to be existent, as under Siedentopf's experiment, does not give any optical solution as to its true shape and size. In fact, it has been mathematically proved, and remains true, to quote Lord Rayleigh's own words, "In the Microscope there is nothing except lack of light to hinder the visibility of an object however small. But if its dimensions be much less than half a wave-length, it can only be seen as a whole, and its parts cannot be distinctly separated, although in cases near the border-line some inference may possibly be founded upon experience of what appearances are presented in various cases. . . . What has been said about a luminous point applies equally to a luminous *line*. If bright enough it will be visible, however narrow; but if the real width be much less than the half wave-length, the apparent width will be illusory."

Elements of Applied Microscopy.*—The author, C. E. A. Wilson, in an apologetic introduction, remarks that this little work which is intended for the teacher and the beginner with the Microscope, contains very few original data, and treats no single subject with completeness. In less than 170 pages, divided into twelve chapters, the author flits over the following fields, functions and parts of the Microscope:—Its manipulation; mounting and preparation; micrometry; common starches; foods and drugs; textile fibres; paper; the Microscope in medicine and forensic medicine; microchemistry; petrography and metallography. To those who desire a superficial glance at the possibilities of the Microscope and its practical application, this elementary treatise may be of service.

Optical Dictionary.†—This new glossary of terms chiefly relating to optics and optical instruments is mainly intended for the use of students and members of the optical industry. It will, however, be found helpful to a wider circle, as it deals with terms used in ophthalmology, photography, mathematics, and closely allied sciences. The volume is edited by C. Hyatt-Woolf.

Microscopist's Screen.‡—J. Peiser describes a screen for protecting the eyes of microscopists against the light. The framework clips on to the ocular and to the ring is attached a T-shaped piece of wire to which is fixed a piece of black satin.

B. Technique.§

(1) Collecting Objects, including Culture Processes.

Flagella of Bacillus Typhosus.—W. J. Dibdin exhibited photographs of the *Bacillus typhosus* at the April meeting, showing the flagella in a more marked manner than usual. It was found as the result of a considerable number of cultures of this organism, that the flagella are most highly developed in cultures which are between 12 and 20 hours old. In the photograph the considerable extensions of the flagella are shown.

The method of preparation was as follows:—The culture used was a 16-hour-old agar streak sub-culture from a gelatin streak culture. Some of the growth, as much as was obtained by touching the culture with a sterile wire, was smeared on a watch-glass and 1 c.cm. of sterile tap-water added. Without mixing in any way, the watch-glass and contents were then incubated at 40° C. for 30 minutes. Drops of the water, throughout which the more active of the flagellated bacilli had spread, were taken from the edges and spotted on cover-glasses. These cover-

* New York, John Wiley and Sons; London, Chapman and Hall (1905) xii. and 168 pp., 60 figs.

† London, Gutenberg Press, Limited (1905) 77 pp.

‡ Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 467–9 (2 figs.).

§ This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

glass preparations were set aside until they had become thoroughly air-dry, and were then fixed in the usual way by passing through a flame.

The dried and fixed preparation on the cover-glass was next flooded with a tannate of iron mordant, and heated till the mordant steamed, when the latter was removed by washing in distilled water. After drying, the mordanting process was repeated, and finally the preparation was stained with Ziehl fuchsin solution.*

The photographs were taken by means of a Powell and Lealand $\frac{1}{12}$ in. apochromatic 1·43 N.A. and No. 10 compensating eye-piece. Messrs. Powell and Lealand's apochromatic condenser was used together with Gifford's light screen, the latter more particularly to absorb some of the heat-rays from the condensed beam of the limelight employed, before they reached the condenser. By means of this arrangement the photographs were obtained with an exposure of three minutes. The magnifications are approximately equal to 2500 and 5000 diameters respectively.

With regard to the question of employing high magnifications, it may be of interest to point out that in the print taken with only 2500 diameters magnification, the appearance in one case is such that it might easily be assumed that the flagella were bifurcated, and at first this was taken to be the case, but the higher magnification clearly shows that this appearance is due merely to juxtaposition of the bent middle portion of a detached flagellum, with the terminal of an attached flagellum.

The fact that the flagella seem to reach their maximum growth in from 12 to 20 hours and then are soon lost, combined with their number and character, suggests the possibility that they are used in the manner of tentacles for attachment until certain functions are discharged, whereupon the flagella cease to be required, and are lost.

Quantitative Estimation of the Bacillus Coli in Drinking Water.†—A. Gautié considers that it is not the mere presence of *B. coli*, but its abundance or rarity that should be regarded as an index of the fæcal contamination of drinking water; a great increase in the number of this microbe in a water that usually contains only a small number, is of equal importance with the sudden appearance of this organism in a water in which it never existed previously. For this quantitative analysis he employs the method of Peré, which consists in the addition to the suspected water of a small quantity of pepton broth and a known proportion of carbolic acid. He gives details of the technique carried out by Peré; this he modifies in practice, by working not only with 100 c.cm. of water, but with decreasing amounts from 100 c.cm. to 1 drop, adding always proportionate amounts of carbolic acid.

Rothberger's Neutral Red Reaction.‡—Otto Heller describes Rothberger's neutral red reaction which is used as a differential diagnosis between *B. typhosus* and *B. coli*. He refers to the several modifications

* Fuchsin solution: 5 p.c. solution of phenol in water. To this add 1 grm. fuchsin and shake well, and add slowly, drop by drop, 10 c.cm. absolute alcohol.

† Ann. Inst. Pasteur, xix. 1905) p. 124.

‡ Centralbl. Bakt., Orig., 1te Abt., xxxviii. (1905) p. 117.

of the method as suggested by different workers, which depend on the variations in the nature or composition of the media employed. He contrasts the media of Rothberger and Oldenkop with media prepared with ordinary broth and gelatin to which neutral red in similar amounts has been added. The details of his observations on 30 different strains of organisms, mostly belonging to the *Coli* group, are given in tabular form. From these results he concludes that the neutral red reaction is best obtained by the use of ordinary laboratory gelatin with the addition of sterilised, saturated, aqueous solution of neutral red, and incubating at 37° C.; under these circumstances he finds that the reaction appears quickly within 6 hours, is uniform and reliable, and remains permanent, being influenced neither by the medium nor by the oxygen of the air.

Methods for Isolating the Micro-organisms of Nitrification.*—R. Perotti uses blocks of commercial carbonate of magnesium, which are sawn up into slices about 10 cm. long, 2·5 cm. broad, and 1 cm. thick. Of course any other size or shape will do. The slices are first polished with glass, and afterwards rubbed down quite smooth with the finger.

The nutritive medium is composed of three solutions. (1) Ammonium sulphate, 2 grm.; potassium phosphate, 1 grm.; magnesium sulphate, 0·5 grm.; distilled water, 1000 grm. (2) Sulphate of iron, 2 grm.; distilled water, 100 grm. (3) Saturated solution of sodium chloride. To 50 c.cm. of (1) are added one drop of both (2) and (3). The solution must be made fresh when required for use.

The magnesium carbonate slab is placed in a tube, and then as much of the medium poured in as will suffice to soak the block and allow a deposit of from 5–10 c.cm. at the bottom of the tube. The whole is then steam-sterilised.

It is important to have some of the medium at the bottom of the tube for the purpose of keeping the slab moist.

The surface of the block is inoculated by running over it a few drops of the fluid containing the micro-organisms.

The presence of the organisms is detected by the appearance of minute excavations of a dirty yellow hue on the surface of the medium.

Endo's Method for Detecting Typhoid Bacilli.†—The medium devised by S. Endo is composed of the following ingredients:—1000 c.cm. neutralised nutrient agar (3 p.c. agar); 10 grm. chemically pure lactose; 5 c.cm. alcoholic solution of fuchsin; 25 c.cm. 10 p.c. sodium sulphite solution; 10 c.cm. 10 p.c. soda solution.

The medium is prepared as follows:—500 grm. of chopped beef, 1 litre of water, 10 grm. of pepton, 5 grm. of salts, and 30 grm. of agar are well boiled, filtered, neutralised, and alkalinised by the addition of 10 p.c. soda solution.

The lactose and fuchsin solution are then added. This makes the medium red, but after the addition of the sodium sulphite it gradually loses colour, and when the agar is set it is quite colourless.

* Atti R. Accad. Lincei, xiv. (1905) pp. 228–31 (1 fig.).
† Centralbl. Bakt., 1te Abt. Orig., xxxv. (1903) pp. 109–10.

The medium is next distributed into test tubes, and steam-sterilised for about 30 minutes. Plates are made from these, and the plates inoculated after the manner recommended by Drigalski and Conradi. *Coli* colonies are red and the typhoid colourless. The latter eventually become larger than the *Coli* colonies. The explanation offered as to the redness of the *Coli* colonies is very plausible; the rosanilin salt loses its colour through the action of the sodium hyposulphite; hence, as the *Coli* bacteria produce acid, they restore the colour.

Simple Medium for Cultivating Gonococcus.* — B. Lipschütz recommends a nutrient medium which contains a 2 p.c. solution of white of egg.

The method of making the medium is as follows: A 2 p.c. solution of white of egg in tap-water is placed in a glass flask, and to every 100 c.cm. are added 20 c.cm. of a $\frac{1}{10}$ normal caustic soda. After half-an-hour, during which time the mixture should be carefully shaken a few times, the raw medium is filtered in quantities of 30–50 c.cm. into Erlenmeyer's flasks, and sterilised two or three times. The albumen mixture should be colourless to pale yellow, quite clear, and alkaline to litmus.

The albumen mixture thus prepared may be added to agar (agar 1 p.c., NaCl $\frac{1}{2}$ p.c., pepton 1 p.c.), or to bouillon in the proportion of one part of the solution to 2 or 3 parts of agar. The broth may be used first and transfers made to the agar in about 48 hours.

The gonococcus colonies are said to be easily distinguished from contaminations.

For the method of obtaining the infective material the original should be consulted.

New Method for obtaining Pure Cultivation of Yeast.† — H. Wichmann and H. Zickes first take a droplet from a suspension of yeast in beerwort and with this make a surface culture on wort-gelatin. In this way droplet-plates are made on square cover-glasses, and placed in a Böttcher's chamber, or over a hollow-ground slide ringed round with thin vaselin. The authors find that this droplet-plate method is suitable for obtaining cultivations of almost all kinds of Blastomycetes.

Effect of Coffein on Typhoid and Coli Cultures.‡—F. Kloumann finds that when coffein is added in slight amount to nutrient media it inhibits the growth of both *Coli* and typhoid bacteria, acting, however, more strongly on the former than on the latter. In stronger concentration the number of *Coli* bacteria is diminished, the effect on typhoid being negative. In still stronger concentration the *Coli* bacteria die off altogether, while the number of the typhoid bacteria are more or less diminished. The author did not find any degree of concentration which would simultaneously inhibit the growth of *Coli* and promote that of typhoid bacteria.

* Centralbl. Bakt., 1te Abt. Orig., xxxvi. (1904) pp. 743–7.

† Allgem. Zeitschr. f. Bierbrauerei u. Malzfabrik., xxxiii. (1905) No. 1. See Centralbl. Bakt., 2te Abt., xiv. (1905) p. 244.

‡ Centralbl. Bakt., Orig. 1te Abt., pp. 312–17.

Fuchsin-Agar as a Diagnostic Medium for Typhoid Bacteria.*— D. S. Petkowitsch recommends a medium with the following composition for differentiating *Bacillus typhosus* from *B. coli* and allied organisms. 1000 grm. neutral agar (3 p.c.); 10 grm. (1 p.c.) milk-sugar; 5 c.cm. (0·5 p.c.) alcoholic solution of fuchsin; 25 c.cm. (2·5 p.c.), 10 p.c. sodium sulphite solution; 10 c.cm. (1 p.c.), 10 p.c. soda solution.

The alkalinity should be at least 0·1 p.c.; usually it amounts to 0·1–0·15 p.c. pure soda, titrated with litmus paper as indicator. On this medium the typhoid colonies are colourless, while those of the *Coli* group are red or reddish in from 15 to 24 hours.

Cultivation of the Leishman Body.†—J. C. B. Statham successfully cultivated the Leishman bodies from a case of Dum-Dum fever in citrated blood, obtained from the spleen and liver. Apparently about 4 c.cm. of blood was mixed with 1 c.cm. of 4 p.c. solution of sodium citrate, and the tubes incubated at 20° C.

Subcultures on the same lines were also successful, but the life-period of the cultivated parasite appears to be limited to 14–21 days.

The ordinary body is roundish, with macro- and micronucleus; after a period of growth the body elongates and develops a flagellum in the vicinity of the micronucleus. The motility of these flagellated forms is sluggish, and the parasites advance with the flagella end foremost. The flagellated parasites may give rise to spirillar forms by a process of unequal longitudinal fission.

Use of Acid Media in Isolation of the Plague Bacillus.‡— W. C. C. Parkes and F. H. Joseph find that by the use of acid media the growth of pneumococcus is inhibited in cultures of sputum of cases affected with plague. By this means the pneumococcus has been eliminated, and the animals which had been inoculated with acid broth culture died of plague infection.

Bacteriology of Plague.§—H. Watkins-Pitchford makes the following interesting observations on the plague bacillus: (1) The *Bacillus pestis* grows vigorously between 15° C. and 40° C., showing the ease with which the organism can adapt itself to the varying seasonal temperature. (2) Growth of the bacillus seems to be almost inhibited in carbonic dioxide. (3) After 50 days' culture in bouillon, with 2·5 p.c. sodium chloride, the plague organism is incapable of further growth when re-transplanted upon other media. (4) The same observation held true after a lapse of 75 days for glucose agar and glucose bouillon. (5) After 100 days, however, the cultures on glycerin agar, ox serum, salt agar, glycerin bouillon, and plain bouillon proved fatal to guinea-pigs. (6) An animal may retain plague bacilli alive within its tissues and not manifest signs of the disease. This was proved by an experiment in which an inoculated rat showed no signs of illness, but when, after 23 days subsequent to inoculation, the rat was killed, a drop of pus was found in a

* Centralbl. Bakt. Orig. 1te Abt., pp. 304–12.
† Journ. Roy. Army Med. Corps, iv. (1905) pp. 13–15, 321–34 (1 pl. and 2 figs.).
‡ Brit. Med. Journ. (1905) i. p. 136.
§ Report on the Plague in Natal, 1902–3. By Ernest Hill. London, Cassell and Co., 1904, 192 pp., with map, charts, and photomicrographs.

gland of the groin, and in the pus a few plague organisms; cultures therefrom proved virulent for guinea-pigs. (7) The liability to confuse the *Bacillus pestis* with such germs as those of chicken-cholera, rabbit septicæmia, swine plague, pneumopleurisy of calves, etc., is insisted upon by the author. He holds that the Microscope alone is incapable of distinguishing between these bacilli, and that it is only by bacteriological investigations and by testing the virulence and behaviour of the bacillus experimentally in animals that a definite and conclusive diagnosis can be made.

(2) Preparing Objects.

Apparatus for the Automatic Fixation of Embryos.*—L. Sanzo describes an apparatus which he has devised for the purpose of automa-

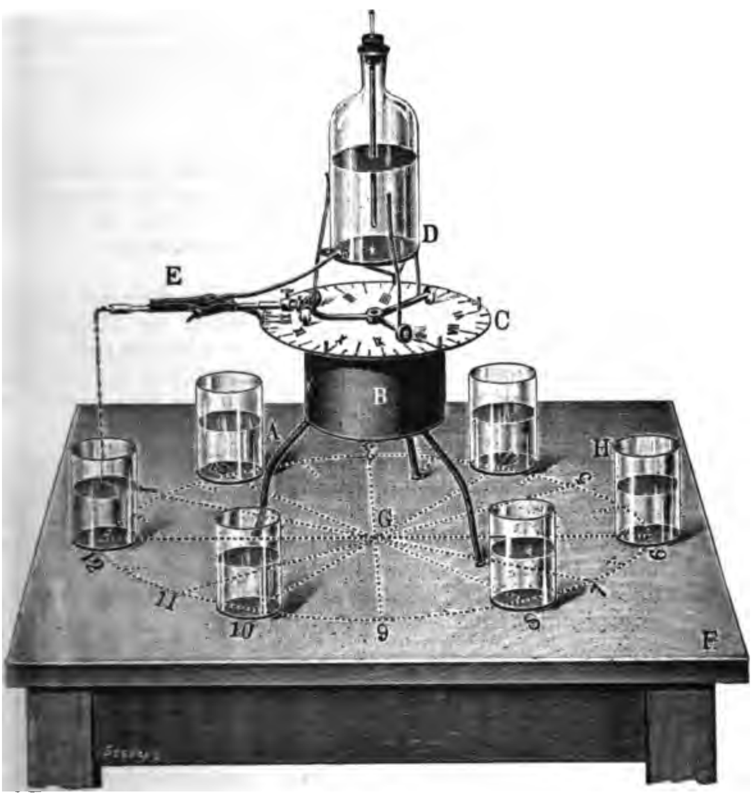

FIG. 68.

tically fixing embryos at any desired stage of development. The essential points are a clockwork motor and a special kind of stopcock or tap (fig. 68). The drum B which contains the motor is surmounted by

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 449–57 (4 figs.).

a plate C. This acts both as a dial and a support for the framework and the bottle D. The dial face C is perforated near the periphery by a series of holes for pegs, which, as the drum revolves, strike a lever, and so cause the tap E to open and let out some of the fixative from the Marriotte's bottle into the beakers. The beakers, which contain the embryos, are ranged round the margin of a divided circle drawn on the table F. It may be seen that, according to the strength of the fixative, the amount of fluid in the beakers, and the number of pegs inserted in the dial face, almost any desired fixation may be obtained for any one or more sets of embryos. For further details of this ingenious apparatus the original should be consulted.

Preparing Germ Cells of Pedicellina Americana.*—L. I. Dublin fixed the material in corrosive sublimate with 5 p.c. acetic acid. The stains employed were Heidenhain's haematoxylin, Auerbach's fluid, thionin, and Flemming's triple stain; but the first gave by far the best results. The colonies were imbedded and sectioned *en masse*, and in this way there were obtained on the same slide, male and female individuals of all ages.

Removing Avian Blastoderms.†—E. A. Andrews finds that by the following method good preparations of blastoderms can be obtained. It consists essentially in separating the blastoderm from the vitelline membrane and of fixing it partially, and then separating it from the yolk while the latter is still fluid.

To accomplish this result, picro-sulphuric acid is injected between the blastoderm and the vitelline membrane. When the blastoderm is partially fixed and become coherent, it is removed with the yolk.

The pipette used has the upper part of sufficient size to hold a fair quantity of fixative, while the lower end is drawn to a point, the extremity being bent at an angle.

Examination of Bone Marrow.‡—C. Price Jones obtains marrow from ribs or vertebræ by squeezing it out of the bone with forceps and transferring on a platinum loop to the following dissociating fluid. The latter is prepared by diluting glycerin with ammonia-free distilled water to form a 10 p.c. solution, and titrating this against decinormal sodium hydrate, using phenolphthalein as indicator. The initial reaction of this solution varies from $+0\cdot1$ to $+0\cdot5$ (Eyre's scale), and has a specific gravity of $1\cdot029$ at $15\cdot7°$ C. A loopful of 10 p.c. glycerin is placed on a coverslip, and to this a loopful of the marrow emulsion is added and spread over the surface of the slip. The film is then air-dried and afterwards fixed and stained with the Jenner bloodstain. It is then washed with distilled water, dried, and mounted. Care should be taken to avoid making the emulsion too concentrated or the films too thick.

Fixation of Tissues by Injection into the Arteries.§—B. D. Myers is enthusiastic over the procedure he adopts for fixing tissues. The

* Ann. New York Acad. Sci., xvi. (1905) pp. 1–64 (3 pls.).
† Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 177–9 (1 fig.).
‡ Brit. Med. Journ., 1905, i. p. 409.
§ Johns Hopkins Hosp. Bull., xvi. (1905) pp. 66–8 (1 fig.).

animals are injected by means of an airblast apparatus or aspirator to which a manometer is attached for indicating the pressure.

The vascular system is first washed out with normal saline and then injected with the fixative heated to 40° C. The solutions used were sublimate, formalin, and Hermann's fluid. The results appear to have been excellent.

Vasoin, B.—Ueber die Veränderungen des Rückenmarkes bei der Fixierung.
[Calls attention to the different histological appearances in the peripheral and central portions of spinal cord after fixation.]
Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 420–31 (1 pl.)

(3) Cutting, including Imbedding and Microtomes.

Paraffin Imbedding Bath.*—The paraffin bath, invented by F. Fuhrmann, is designated a universal paraffin imbedding thermostat, as it is adapted for *in vacuo* as well as the ordinary impregnation. The con-

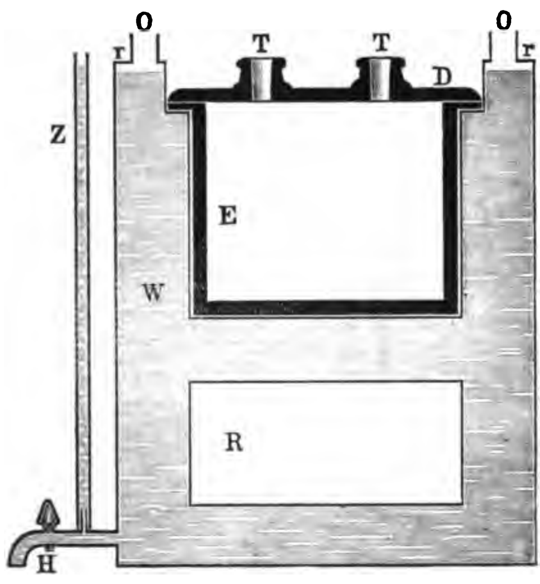

Fig. 69.

struction is shown in the accompanying illustrations (figs. 69, 70). R is the ordinary and E the vacuum bath. O, O are openings for thermometer and thermo-regulator. Z is the water-level, and H the outflow-tap. D is the lid of the vacuum bath, and the two holes therein are for a thermometer and the exhaust tube which is provided with two stop-cocks and a manometer. The case is made of copper and is covered

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 462–7 (2 figs.).

with linoleum. Fig. 69 shows the bath in section. Fig. 70 gives the outside view of the apparatus. The air pump and other accessories thereto are omitted.

FIG. 70.

Reichert's Medium Microtome.*—The section-cutting in this apparatus (fig. 71) is regulated by the draw-back of the knife, so that, at pleasure, a thickness of from 0·002–0·02 mm. may be automatically obtained, and a series of uniformly thick sections produced. As the object is only moved vertically, a much shorter bed-length will suffice than in oblique microtomes. The object can be directly inserted, or imbedded in paraffin, or celloidin, in the usual way. The bed and frame are made of cast-iron. The micrometer screw is worked with especial care, and has a diameter of 10 mm. and a pitch of 0·4 mm. A zinc-

* C. Reichert (Vienna), Catalogue No. 25 (Mikroskopie, 1904) p. 58, fig. 29.

plate tray is provided to catch droppings from the machine and keep the working table clean. The bed-length is 28 cm.

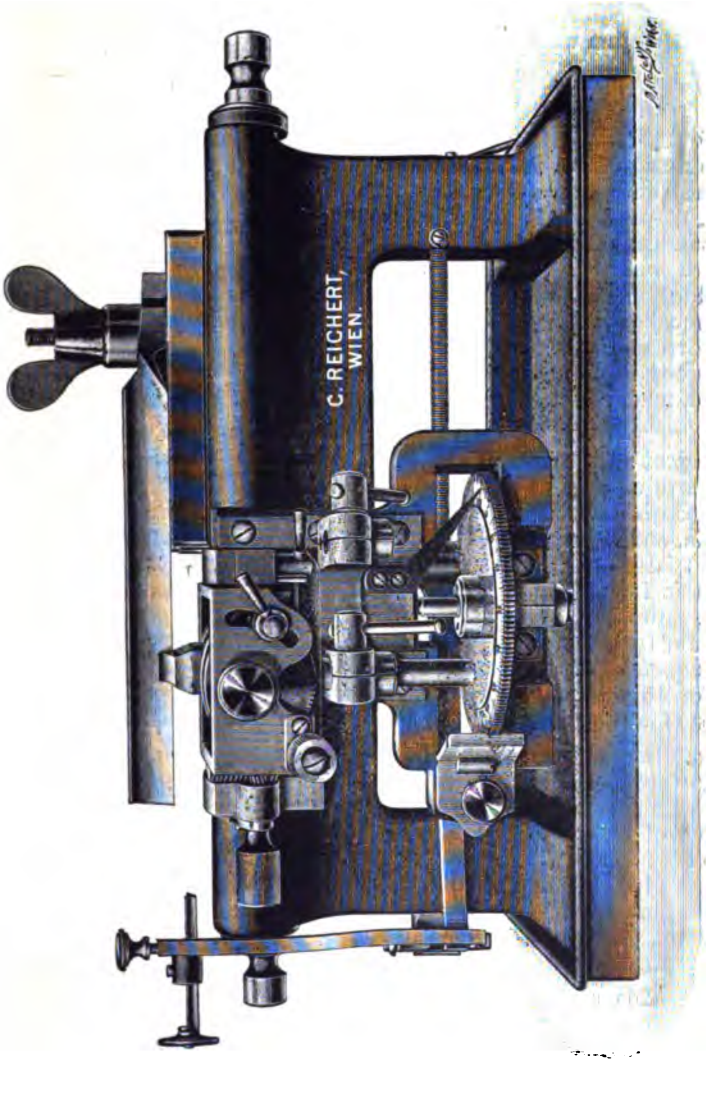

Fig. 71.

Use of Iodine after Fixation in Sublimate.*—R. Pirone finds that sublimate is more rapidly removed when the material is treated in the

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 179–81.

section stage, than in bulk. The sections are left for 20–25 minutes in iodo-potassic iodide solution (Mayer's formula), diluted with distilled water to a wine-colour or in 70 p.c. alcohol mixed with the same iodine solution. On removal the sections are washed in alcohol to remove the iodine, and, in case they remain yellow, they are treated with magnesium water.

(4) Staining and Injecting.

Method of Differentiating the Cortical from the Medullary Portions of Adrenals.*—O. V. Sdrinko fixes the adrenals of man and other mammals in 4–5 p.c. formalin (commercial formalin, 5 parts; distilled water, 95 parts). The solution is renewed every two days for a week to a fortnight. The material is then washed for about half an hour in distilled water, and after treatment with 70 and 90 p.c. alcohol, is imbedded in celloidin or paraffin. The celloidin sections are stained with equal parts of ripe Böhmer's hæmatoxylin and distilled water for about five minutes. They are then washed and mounted, or they may be contrast-stained with eosin. By this method the medullary portion is stained much darker than the cortical, and removes any difficulty of distinguishing between the cells of the two parts.

Fugent: a New Stain.†—F. H. Joseph communicated a note on the above at the January meeting of the Pathological Society. The stain consisted of a mixture of alcoholic solutions of methylen-blue, fuchsin, and gentian-violet. The following formula was arrived at after many trials:—(1) Methylen-blue, saturated alcoholic solution, 4 parts; (2) basic fuchsin, saturated alcoholic solution, 3 parts; (3) gentian-violet, saturated alcoholic solution, 5 parts. The mixture is allowed to stand for from three weeks to a month. One part of the stain is diluted with 2 parts of distilled water, and allowed to remain on the dried cover-slip for 45 seconds, washed in water, dried, and mounted. Bacteria appear of a deep red colour, whilst the capsules are of a light violet tint.

Staining Arteries.‡—T. D. Savill recommends acid orcein for staining sections of arteries. The solution gave better results after fixation with alcohol than with bichromate or other fluids. The mixture consists of neutral orcein, 2 grm.; hydrochloric acid, 2 c.cm.; alcohol (70 p.c.), 96 c.cm. The sections are removed from 60 p.c. alcohol, and immersed in the filtered stain for 4 or 5 minutes. After washing in weak spirit, the sections are dehydrated in absolute alcohol and mounted in balsam.

Demonstrating the Finer Structure of the Nervous System.§—E. S. London adopted the following procedure for studying the finer nerve-structures of the leech, white mice, and dogs. Pieces were placed in ammoniated alcohol (4 c.cm. ammonia in 96 p.c. alcohol). After 24 hours the pieces were cut up into slices 2–3 mm. thick, and placed in

* Anat. Anzeig., xxvi. (1905) pp. 172–4 (1 fig.).
† Brit. Med. Journ., 1905, i. p. 136.
‡ Trans. Path. Soc., lv. (1904) p. 412.
§ Archiv Mikrosk. Anat., lxvi. (1905) pp. 111–15 (1 pl.).

fresh ammonia-alcohol for 1–2 days. On removal they were washed for 5–10 minutes in distilled water, and then impregnated with 1 p.c. silver nitrate (3–6 days at 35°–37° C.). On removal the pieces were dried with blotting paper, and then developed in diffused light in pyrogallol solution (pyrogallol 2, formalin 5, distilled water 100). This was followed by alcohol, chloroform, imbedding in paraffin, sectioning. The sections were placed in 1 p.c. gold chloride solution for 5–10 minutes, and then in 5 p.c. sodium hyposulphite for 5–10 minutes, after which they were mounted. If the sections be too thick it is advisable to omit the gold stage. Pieces thus treated are free from precipitate.

Differential Staining of Typhoid Bacilli in Sections.*—H. Bonhoff recommends a modification of Pick and Jacobsohn's method of demonstrating gonococci in tissues for the differential staining of *Bacillus typhosus* in sections. Instead of 8, he uses 4 drops of a saturated alcoholic solution of methylen-blue, and adds these to 15 drops of Ziehl's solution, and 10 c.cm. of distilled water. The stain is first allowed to act for 2 minutes cold, and is then gently warmed. 1 p.c. acetic acid is used for differentiating. After washing, the section is dehydrated in anilin-xylol (equal parts). The typhoid bacilli are deep blue on a red background.

Spore Staining.†—E. Thesing mordants the films with hot 1 p.c. platinum chloride solution. After washing and drying, the film is hot stained, and then thoroughly washed with 33 p.c. alcohol. The film is again dried and contrast-stained in the cold for 3 minutes.

New Method of Spore Staining.‡—Scagliosi recommends that the material should be fixed with van Gehuchten's or Hermann's fluid. After staining with carbol-fuchsin, wash in water or dilute sulphuric acid, and contrast-stain with methylen-blue.

Method of Staining Sensory Nerve Sheaths.§—A. Ruffini describes a method for staining the subsidiary sheath of sensory nerves. (1) Small pieces of skin or muscle are left for half an hour or more in a solution composed of 20 p.c. formic acid 66 parts, and hot saturated aqueous solution of sublimate 34 parts. This mixture must be prepared some time in advance. (2) The pieces are washed quickly in running water. (3) They are placed for 20–40 minutes in 1 p.c. solution of gold chloride. (4) They are mopped up with blotting paper, and placed in 2 p.c. solution of formic acid, and kept in the dark for 12–15 hours. (5) The vessel is then exposed to sunlight for 6–8 hours. (6) The pieces are dried carefully and placed in glycerin. (7) After 8–10 days they are teased out and mounted in glycerin.

New Method for Staining Glycogen.‖—A. Fischer describes the following method for staining glycogen, which was tested on the liver of the pig and mouse. Fixation in alcohol: the paraffin sections are

* Archiv Hygien, l., No. 3. See also Zeitsch. angew. Mikr., x. (1905) p. 301.
† Loc. cit. See also Zeitschr. angew. Mikr., x. (1905) p. 306.
‡ Riforma Med., 1904, No. 49. See also Centralbl. Bakt., 1te Abt. Ref., xxxvi. (1905) pp. 263. § Zeitschr. wiss. Zool., lxxix. (1905) p. 151 (2 pls.).
‖ Anat. Anzeig., xxvi. (1905) pp. 399–400.

placed in alcohol and passed straight away to a 10 p.c. aqueous solution of tannin for 10–15 minutes. The sections are washed in 1 p.c. solution of potassium bichromate and then placed for 10-15 minutes in 10 p.c. potassium bichromate for fixation. The glycogen is by this time almost insoluble, and will stand washing with water and staining with aqueous solutions. Staining for 10 minutes in safranin-anilin water solution gives beautiful pictures. After staining, the preparation is rapidly treated with alcohol and xylol, and mounted in balsam.

Other basic anilin dyes, such as gentian-violet, methylen-blue, etc., may be used; these stain only the glycogen. The acid anilin dyes do not stain.

Pyronin Methyl-Green.*—Whitney recommends a 1 p.c. solution of these two pigments, mixed in the proportion of 4 parts of the pyronin to 1 part of the methyl-green solution, as an effective double stain for cells and bacteria.

Methods of Staining the Diphtheria Bacillus.†—J. M. Blumenthal and M. Lipskeron in an interesting and useful contribution on the comparative value of the differential methods for staining the diphtheria bacillus, award the palm to the methods of Falières and of Ljubinsky. In the former the staining solution is composed of methylen-blue 2, borax 0·5, distilled water 100, absolute alcohol 8 drops.

After washing in tap-water the stained film is further treated for half-a-minute with a 1 : 1000 aqueous solution of vesuvin. The granules of the bacteria are stained blue, and show up well on the brown background.

Ljubinsky's method consists in staining the fixed film for ½–2 minutes with a solution composed of Merck's pyoktanin 0·25; acetic acid (5 p.c.) 100.

After washing with water the preparation is after-stained for half-a-minute with a 1 : 1000 solution of vesuvin.

The results are stated to be excellent, but the authors think they have improved on it by substituting chrysoidin for vesuvin, using, however, a solution three times as strong.

Eleven other methods are described, but for these the original should be consulted.

Staining Negri's Bodies in Hydrophobia.‡—G. Fasoli adopts the following method. The material is fixed in sublimate solution, and the sections first stained with aqueous eosin. After washing with water they are differentiated with alcohol, made alkaline with a few drops of 1 p.c. soda solution. The sections are again washed, and then stained with methylen-blue, until they are of a pale blue colour. After dehydration they are cleared up with xylol, and mounted in balsam.

New Yolk Stain.§—K. Peter gives the following modification of Spuler's iron cochineal stain. 10 grm. of powdered cochineal are boiled in 250 c.cm. distilled water, and the decoction evaporated down to

* Boston Med. and Surg. Journal, May 1903.
† Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1905) pp. 359–66.
‡ Policlinico sez. Med., 1904, No. 7. See also Centralbl. Bakt., 1te Abt. Ref., xxxvi. (1905) p. 385.
§ Zeitschr wiss. Mikrosk., xxi. (1904) pp. 314–20.

50 c.cm. After filling up to 150 c.cm. with distilled water, it is filtered, and to every 40 c.cm. of the filtrate, 3 drops of pure hydrochloric acid are added. After the precipitate has subsided, the clear orange-red fluid is ready for use.

Paraffin sections are incubated in the stain for 18–24 hours, and then, after a washing with distilled water, are treated for ½–2 minutes with 1 p.c. iron-alum solution, which, should they turn black, is changed. The sections are again washed and then passed through graded alcohols to xylol and balsam.

For staining *en masse* the pieces are incubated for 48 hours, and mordanted with the iron-alum solution ; if a 2½ p.c. be used, then for 15–60 minutes ; if a 1 p.c., for 12–24 hours.

The preparations show the chromatin of the nuclei black, the protoplasm grey, the yolk granules red, nucleoli red.

If the centrosomes are to be stained, the following modification must be adopted. The sections are stained for one day in the cochineal decoction, and, after a short mordanting, are placed in Weigert's hæmatoxylin solution for two days, after which they are differentiated in 2½ p.c. iron-alum solution.

The material used was chiefly the larvæ of *rana esculenta*, and the best fixative was found to be Zenker's fluid.

Demonstrating Fatty Infiltration in Tissue.*—P. Foà has abandoned the method of fixing the material with Flemming's fluid and staining with safranin and picric-alcohol, for Marchi's method, which he finds more effective.

The pieces are placed for 3 or 4 days in Müller's fluid, and then transferred for a similar period to the osmic-bichromate mixture. On removal they are washed and then hardened in alcohol. By this procedure the elasticity of the tissues is well preserved, the osmic acid penetrates thoroughly, and the sections can be stained with hæmatoxylin and eosin, or by Van Gieson's method.

KAPPERS, C. U. A.—**Ein kleiner apparat für die Gesamtbehandlung vieler Objektträger.** (A clamp for holding together and simultaneously treating several slides.) *Zeitschr. wiss. Mikrosk.*, xxi. (1904) pp. 185–8 (1 fig.).

LICHTENBERG, S.—**Objektträgergestell zur gleichzeitigen Behandlung zahlreicher Schnitte.** (A frame for the simultaneous treatment of numerous sections.) *Tom. cit.*, pp. 321–4 (1 fig.).

(5) Mounting, including Slides, Preservative Fluids, &c.

Copal as a Mounting Medium.†—J. G. R. Powell recommends copal dissolved in absolute alcohol for mounting vegetable sections. Though somewhat difficult to prepare, it acts well. It is not suitable for diatoms. Apparently it takes about two months to dissolve properly.

Method for Removing Small Quantities of Centrifuged Deposit.‡—G. C. Van Walsem uses a Pravaz's syringe, and fills the canula and

* Atti R. Acad. Sci. Torino, xl. (1905) pp. 65–78 (1 pl.).
† English Mechanic, lxxxi. (1905) p. 133.
‡ Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 172–4 (1 fig.).

lower part of the syringe with olive oil. The whole or any part of the deposit is sucked up by turning round the screw ring on the piston rod. The canula should be quite 4 cm. long, and have the ends rounded off.

(6) Miscellaneous.

Modification of Cornet's Forceps.*—V. Schläpfer describes the following modification of Cornet's forceps. One half of the instrument (fig. 72) is at the same time the spring and the handle. To the rounded ends are jointed on the grips, the ends of which are curved so that when closed they form an ellipse. The great advantage of this form of

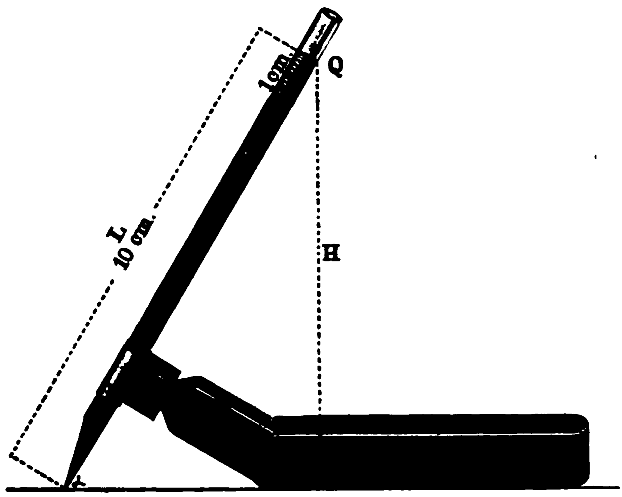

FIG. 72.

grip is that the staining fluid does not run under as it does in the ordinary pattern. It will serve to hold capillary pipettes as shown in the illustration, as well as cover-glasses.

Simple Method for Distinguishing between Human and Animal Blood.†—H. Marx and E. Ehrnrooth describe a method for distinguishing between the blood of man and the lower mammalia. It depends on the observation that the action of homologous and heterologous sera on fresh human blood is recognisable under the Microscope. Human red corpuscles are rapidly agglutinated by an alien serum, the erythrocytes becoming pale and accumulating in clumps directly after contact with the foreign serum. The technique is simple. A solution of the suspected blood is made with 0·6 p.c. salt solution. Some of this is placed on a slide, and to it is added a droplet of fresh human blood. The two

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 458–60 (1 fig.).
† Münchener Med. Wochenschr., li. (1904) p. 293 (2 figs.).

are stirred together with a glass rod, and the mixture having been covered with a slip, is observed under the Microscope.

The fresher the heterologous blood, and the more concentrated the solution, the more rapid is the reaction.

Permanent preparations showing the reaction may be made in the usual way.

Apparatus for Making Wax Plates for Reconstruction Models.*— A. Fleischmann uses a smooth cast-iron plate (60 by 90 cm.), levelled by means of adjusting screws as a surface for rolling out wax plates. The roller is 50 cm. long, and 4 cm. in diameter, and is made of steel. A circular disc is inserted between the handles and each end of the roller for the purpose of regulating the thickness of the plate. This device is far more effective than placing strips of glass or metal on the table.

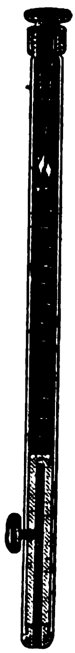

FIG. 73.

Needle for obtaining Blood for Examination.†—J. Ries describes a needle which he has invented for the purpose of pricking the skin to obtain blood for microscopical and other examinations. As will be seen from the illustration (fig. 73), the head, which is perforated for the reception of the needle, is actuated by a spring. The needle is fixed by a screw, the head of which is pressed into the side groove. By exerting slight pressure on the knob the spring is released, and a rapid and painless incision made in the skin. The upper end of the case serves to keep spare needles in.

Examining Caoutchouc by the Aid of the Microscope.‡ P. Breuil examines caoutchouc by reflected and by transmitted light, by the aid of a Microscope which is also fitted up for photographing the preparations. Thin films are obtained by evaporating solutions of caoutchouc in divers solvents. Delicate transparent strips may also be used. For examining with reflected light, an arc light of 20 amperes is necessary, and the specimens used are prepared after the manner used in metallography, i.e. the pieces are shaped, polished, and etched with sulphuric and nitric acids. Microscopical inspection enables the observer to detect the nature and purity of the rubber, as well as the presence of impurities and adjuvants.

SCHAPER, A.—Eine Methode zur Durchschneidung grober Wachsplatten Modelle.) (Method for cutting through large wax plates by means of a thin metal wire heated by the electric current.) *Zeitschr. wiss. Mikrosk.*, xxi. (1904) pp. 200–6 (4 figs.).

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* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 479–80 (2 figs.).
† Tom. cit., pp. 445–6 (1 fig.)
‡ Comptes Rendus, cxl., (1905) pp. 1142–3.

Metallography, etc.

The Defects in Ingot-Iron Castings.*—K. H. Wedding classifies the defects in ingot-iron castings, usually termed steel castings, as (1) blowholes, (2) shrinkage cavities, (3) gas cavities from other sources, (4) surface markings, (5) cracks. The ingot-iron is generally made in the open hearth furnace, or in the crucible, seldom in the Bessemer converter. Blowholes are caused by the liberation of gas during solidification of the molten metal, all carbonised iron when fluid having the property of absorbing gases. The addition of silicon or aluminium prevents the formation of blowholes by causing the gases to remain alloyed with iron, manganese having a contrary effect. Shrinkage cavities—"pipes"—are a consequence of the contraction of iron during solidification and cooling, and are usually unavoidable. Small pores between the crystals, only visible by means of the Microscope, may be attributed to the separation of gas, and are essentially harmless. Surface markings have been attributed to segregation. Cracks are caused by contraction, and their formation is influenced by chemical composition. Cavities may be filled by electric welding, by pouring molten iron over the defective part, by thermit treatment, or by hammering in iron at a welding temperature. The results of filling by these methods are frequently not satisfactory.

Notes on the Etching of Steel Sections.†—W. C. Smeaton distinguishes the processes by which the micro-constituents may be differentiated on the polished surface of a metal, as (1) heat-tinting, (2) electro-deposition, (3) polishing in bas-relief, (4) use of solvent etches. The last method is the only one fully dealt with by the author. The nature of the polished surface affects the etch: crystals of the same constituent may be differently coloured by a reagent owing to the plane surface of the section cutting them in different relations to their crystallographic axes. Solid solutions are attacked most rapidly. α-, β-, and γ-iron are attacked at different rates by the same reagent. Beilby has shown that surface flow on metals, caused by the mechanical work involved in polishing, results in the formation of a surface film, differing from the mass of the metal. This film must be removed by the etching agent in order to develop the true micro-structure. Carborundum and wet rouge used as polishing agents on surfaces at high speeds, lead to the formation of pronounced films. Alumina is not so liable to cause films. Surface flow may be diminished by care in polishing. 2 p.c. sulphuric acid, acting at 60° C. for 2 minutes, removes films, producing only a very light etch. The etching action is approximately proportional to the degree of electrolytic dissociation of the active etching agent in the case of water solutions of nitric acid, ammonium nitrate, etc. The author adds an indifferent substance with a common ion, e.g. potassium or sodium nitrate with nitric acid, to alter the electrolytic dissociation. Solutions of potassium and sodium salts are without noticeable etching action. Ammonium salts have an etching action; concentrated solutions,

* Iron and Steel Mag., ix. (1905) pp. 209–21.
† Tom. cit., pp. 222–30 (1 fig.).

however, do not give good results: 2 p.c. ammonium nitrate has been found most satisfactory, especially at 40° C. Persulphates have also been employed. Reaction velocity is of importance, and is in most cases increased by rise of temperature.

The Effects of Momentary Stresses in Metals.*—B. Hopkinson gives the results of his experiments in which the extension of copper and iron wires, subjected to momentary stresses, was measured. A piece of wire, of No. 10 gauge, and about 30 ft. long, was hung vertically, being fixed at its upper end. It was kept taut by a tension (20 to 200 lbs.) applied at the lower end, and a cylindrical 1 lb. weight allowed to fall down the wire, being arrested by a stop fixed to the end of the wire. The extension on 20 in. was determined by an arrangement devised for the purpose, and was found to be in close agreement with the extension calculated from J. Hopkinson's formula. The author concludes that iron and copper wires may be stressed much beyond the static elastic limit, and even beyond their static breaking loads without the proportionality of stresses and strains being substantially departed from, provided that the time during which the stress exceeds the elastic limit is of the order of $\frac{1}{1000}$ second or less.

Further Observations on Slip-Bands in Metallic Fractures. Preliminary Note.†—W. Rosenhain has employed a new method of investigating the micro-structure of metals, to meet the criticisms of F. Osmond and others on the conclusions reached by J. A. Ewing and the author, as to the nature of slip-bands. The difficulties met with in the examiation of a transverse section of a metallic surface, upon which slip-bands had been produced, were overcome by electro-deposition of another metal on the surface. The piece of metal was then cut through and polished, a sectional elevation of the surface being thus obtained. Strips of the mildest steel were polished along a short portion of their length, and were then strained in tension to produce slip-bands on the polished surface. A thin film of copper was deposited from a bath of copper cyanide. The pieces were then removed to the usual copper sulphate bath, and a thicker layer (4–5 mm.) deposited. Sections were made, roughly parallel to the direction of the original tensile strain, at right angles to the surface showing slip-bands. Calcined magnesia was used as the final polishing medium, as rouge eroded the surface. The film of metal smeared over the boundary was removed by slight etching with picric acid. A clearly defined boundary line between iron and copper was then visible, showing well marked steps or serrations. The author concludes that the sectional views of slip-bands thus obtained, strongly confirm the theory of deformation by slip. He suggests that the method of investigation described might be applied to the study of a number of questions, and has employed it in obtaining sections of fractures, with satisfactory results.

Effects of Stress upon Metals.‡—E. G. Crocker describes the behaviour of metals when subjected to stress. The recovery of over-

* Proc. Roy. Soc., lxxiv. (1905) pp. 498–506 (2 figs.).
† Tom. cit., pp. 557–62 (4 figs.).
‡ English Mechanic, lxxxi. (1905) pp. 146–7.

strained specimens is hastened by raising the temperature, and retarded or arrested by lowering the temperature. The formation of slip-bands on a polished surface, subjected to tensile stress, is described.

Metallography of Quenched Steels.*—M. Kourbatoff has experimented with a large number of etching reagents, to determine which are the most useful for the differentiation of the constituents of quenched steels. Three samples of steel, selected to give a great variety of constituents, were etched with the different solutions; they were (1) steel containing 1·8 p.c. carbon, quenched during the recalescence; (2) the same, quenched when one end of the specimen was at its melting point, the other end being cold; (3) steel containing 15 p.c. nickel, 0·8 p.c. carbon. The possible causes of the varying colorations of different constituents upon etching are discussed, the author concluding that the colorations are probably due to the formation of complex organic compounds, in which the nitro groups present in many reagents are concerned. The rapidity of action of solutions of nitric or picric acids appears to depend on the electric conductivity of the liquid. The most suitable reagents for distinguishing the constituents are: (*a*) solution of 4 p.c. nitric acid in iso-amyl alcohol; (*b*) solution of 20 p.c. hydrochloric acid in iso-amyl alcohol, to which is added $\frac{1}{5}$ of its volume of a saturated solution of nitraniline or nitro-phenol in ethyl alcohol. The best reagents for colouring sorbite and troostite without acting upon other constituents are: (*c*) equal parts of a solution of 4 p.c. nitric acid in acetic anhydride, methyl alcohol, ethyl alcohol, and iso-amyl alcohol; (*d*) 3 parts of a saturated solution of nitro-phenol, 1 part of a 4 p.c. solution of nitric acid in ordinary alcohol.

From experiments on re-heating quenched samples, the author concludes that: (1) during re-heating austenite changes to sorbite; (2) martensite decomposes into layers of cementite and crystals of sorbite; (3) at 300° the whole of the martensite and austenite are changed to sorbite and cementite; (4) troostite remains unchanged up to 400°. The hardness of austenite appears to be variable in different samples and in different parts of the same sample.

The Cooling of Steel in Quenching.†—P. Lejeune gives a number of cooling curves, obtained by the Saladin photographic method—in which two galvanometers are employed—of samples of steel quenched in different liquids. The author concludes that quenching in small volumes of mercury is less rapid than quenching in water. The influence of the viscosity, boiling-point, and specific heat of the quenching liquid were also investigated.

Aluminium Steels.‡—L. Guillet has continued his researches on alloy steels. Two series were employed, one containing 0·15 p.c., the other 0·75 p.c. carbon, the aluminium varying in each series from 0 to 15 p.c. Physical properties and microstructure were studied in the steel (1) as forged, (2) quenched, (3) annealed. Up to 2 p.c. the influence of aluminium is slight. The pearlite appears to be more

* Rev. Metallurgie, ii. (1905) pp. 169–86 (23 figs.).
† Tom. cit., pp. 299–311 (10 figs.).
‡ Tom. cit., pp. 312–27 (24 photomicrographs).

compact and to lose its lamellar structure, these effects being more pronounced as the percentage of aluminium increases. With the higher proportions of aluminium a new constituent, exhibiting all the characteristics of cementite, is distinguished. The belief that aluminium causes the separation of graphite in steel is shown to be erroneous. Steel containing 3 p.c. or more of aluminium is brittle. Aluminium also causes some increase in hardness. The aluminium appears to exist in the state of solution in the iron, and when notable quantities of aluminium are present, this solution is incapable of dissolving carbon, even at high temperatures.

FLATHER, D.—**Case-hardening.**
[Describes the most modern methods of carrying out this operation.]
Iron and Steel Mag., ix. (1905) pp. 305–22 (1 fig.)

GIRAUD—**Constitution du Cuivre Oxydé.** *Rev. Metallurgie*, ii. (1905). pp. 297–8 (5 figs.).

Special Nickel-Steel Alloys. *Iron and Steel Mag.*, ix. (1905) pp. 256–60.

STEAD, J. E.—**Science in the Iron Foundry.** *Tom. cit.*, pp. 322–34.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 19TH OF APRIL, 1905, AT 20 HANOVER SQUARE, W., D. H. SCOTT, ESQ., F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 15th of March, 1905, were read and confirmed, and were signed by the President.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society voted to the donors.

	From
Hyatt-Woolf, C. The Optical Dictionary. (8vo, London, 1904)	*The Publishers.*
Winslow, C. E. A. Elements of Applied Microscopy. (New York, 1905)	*The Publishers.*
An Old Portable Microscope. By W. & S. Jones	*Mr. W. S. Rogers.*

The Old Portable Microscope by W. & S. Jones, presented by Mr. W. S. Rogers, was described by Mr. Rousselet in a short paper read by the Secretary.

Mr. W. J. Dibdin exhibited a slide of *Bacillus typhosus*, and explained the method adopted in staining and mounting. He also exhibited some photomicrographs of this organism with well-displayed flagella, taken by lime-light with a 3 minutes exposure under a $\frac{1}{12}$ in. apochromatic objective × 5000 diameters. He stated that he had found the flagella to be much more frequent in cultures incubated at a temperature of 40°, and that they were only present in the young specimens, the average length of the flagella being about ten times the length of the body. He suggested that the use of this might be to enable the bacillus to hold on to the tissues until a more mature stage was attained. In one case he thought some of the flagella were bifurcated, but examination under a power of 5000 diameters proved that this was not the case.

The President, after inspecting the slide referred to, said he had never seen the flagella so well previously as they were shown under the Microscope on the table. In the photographs, also, they were remarkably distinct, and he thought Mr. Dibdin was to be congratulated upon his success. The flagella were important as bearing on the affinities of the Bacteria. Ciliated zoospores were known in certain

fungi, but they were very different from the flagellate cells of the Bacteria. The presence of the flagella quite removed the Bacteria from the mould fungi, with the oidia of which they were once compared. It was a very puzzling thing that these flagella should only be found in the case of young cultures.

The thanks of the Society were unanimously voted to Mr. Dibdin for his exhibit.

Mr. A. E. Conrady gave a *résumé* of his paper, "On the Application of the Undulatory Theory to Optical Problems," diagrams in illustration of the subject being shown upon the screen. He said that as the paper itself was largely mathematical, it was not quite suitable for reading, but by the aid of the diagrams he was able to give a general idea of its contents in a manner which would, perhaps, be more clearly understood.

Dr. Spitta said it was not given to everyone to understand a mathematical formula, but when they had the subject reduced to a graphical representation such as Mr. Conrady had shown them upon the screen, what was otherwise too abstruse now became intelligible to most people. He was curious to know if the method of explaining this subject had originated in Mr. Conrady's fertile brain, as he did not remember to have met with it in any of the text-books.

Mr. Conrady said that this very interesting analogy was not originally devised by himself, but would be found in the article on the Wave Theory by Lord Rayleigh in the "Encyclopædia Britannica." It might have found its way into some text-book, but he could not give a reference to one.

The President said he felt very strongly that papers of this kind, dealing with Optics as bearing on Microscopy, were among the most valuable of the contributions made to the Society. The present paper, though put before them so clearly, was one which few Fellows would feel able to discuss on the spur of the moment, but it would certainly be read with great interest when it appeared in the Journal.

The thanks of the Meeting were cordially voted to Mr. Conrady for his communication.

The Secretary read a letter from Mr. Alfred Mark Webb, Secretary of the Selborne Society, inviting the assistance of Fellows of the R.M.S. as exhibitors at the Selborne Society's soirée at the rooms of the Civil Service Commission in Burlington Gardens on May 3rd.

Also from the Secretary of the Manchester Microscopical Society, calling attention to the publication of their Proceedings, and the terms on which copies could be obtained.

He also mentioned that some slides of Bacteria had been received from Mr. C. J. Pound, of the Stock Institute, Brisbane, for distribution to Fellows interested in the study; these could be obtained on application to the Assistant Secretary after the holidays.

At the close of the Meeting the President made special reference to

the large and interesting exhibition of objects from pond life, and on behalf of the Society gave cordial thanks to those gentlemen who had contributed so largely to the success of the evening.

The following Objects, Instruments, &c., were exhibited :—

The Society :—An old portable Microscope by W. & S. Jones, said to have belonged to Dr. Jenner.

Mr. A. E. Conrady :—Diagrams shown on the screen in illustration of his Paper.

Mr. W. J. Dibdin :—A slide of *Bacillus typhosus*, and photographs of the same × 2500 and 5000 diameters.

Mr. F. W. Watson Baker :—*Lophopus crystallinus*, *Melicerta ringens*, *Stephanoceros Eichhorni*.

Mr. T. N. Cox :—*Anacharis alsinastrum*, showing cyclosis.

Mr. A. Downs :—*Stentor niger*, *Volvox globator*, *Vorticelli*.

Mr. W. C. Flood :—*Volvox globator*.

Mr. E. Hinton :—*Chætophora* sp.

Mr. J. T. Holder :—*Lophopus crystallinus*.

Mr. E. Leonard :—*Daphnia vetula*.

Mr. J. Milton Offord :—*Stephanoceros Eichhorni*.

Mr. G. H. J. Rogers :—*Volvox globator*.

Mr. C. F. Rousselet :—*Brachionus pala*, *B. angularis*, *Limnias annulatus*, *Melicerta ringens*, *Stephanoceros Eichhorni*, *Synchæta pectinata*, *S. oblonga*, *Brachionus pala* (mounted), *Lophopus crystallinus*, zoæa stage of a marine crustacean.

Mr. Geo. Tilling :—*Stephanoceros Eichhorni*.

Mr. H. Taverner :—*Arrenurus maculator* ♂.

Mr. W. R. Traviss :—*Carchesium* sp.

New Fellows :—The following were elected *Ordinary* Fellows :—Messrs. Edward Phelps Allis, jun., Charles Poulett Harris, M.D., and Joseph Kitchin.

MEETING

HELD ON THE 17TH OF MAY, 1905, AT 20 HANOVER SQUARE, W., DR. D. H. SCOTT, ESQ., F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 19th of April, 1905, were read and confirmed, and were signed by the President.

The List of Donations to the Society since the last Meeting (exclusive of exchanges and reprints) was read, and the thanks of the Meeting were voted to the donors.

	From
An Old Microscope, by Nathaniel Adams	*Mr. J. E. Haselwood* per *Mr. C. Lees Curties*
24 Micro Slides	*Mr. W. Mountier Bale*

Mr. C. F. Rousselet gave a description of an Old Microscope of the Culpeper-Scarlet type, made by Nathaniel Adams, date about 1740, presented to the Society by Mr. J. E. Haselwood, through Mr. Charles Lees Curties, and differing from others of the period by having four brass legs instead of the usual three—on which account it was regarded as a very interesting addition to the Society's collection.

Mr. Rousselet also described a "Lucernal" Microscope, exhibited in the room, and presented to the Society by Colonel Tupman. This instrument—made by W. and S. Jones—had its various parts mounted on a long board, the eye-piece consisting of a lens about 5 inches in diameter, mounted at the end of a pyramidal wooden box forming the body of the Microscope. The arrangement gave a very fair image when seen through a ring fixed at a distance of about 14 in. from the eye-lens, but it was obviously a very inconvenient instrument to adjust and use.

Mr. D. D. Jackson's paper, "On the Movements of Diatoms and other Microscopic Plants," was read by the Secretary.

The President said it was evident that they had in this paper a communication of very great interest, upon a subject which had been discussed ever since these organisms had been known. He did not think, however, that the author had mentioned all the theories which had been put forward to account for these movements. It had been suggested by Max Schultze that they were due to a kind of amœboid motion of the protoplasm on the exterior of the diatom, by which it was moved along the surface of any body with which it was in contact, but it had since been found that diatoms also moved when quite free. Otto Müller also referred the motion to currents of protoplasm, but found that they had a curved screw-like course—a reacting on the surrounding water. He worked out the theory with great elaboration.

Mr. Jackson's gas theory was one which he had not met with before, though he was not sure that the idea was altogether new.

Mr. Karop suggested that it might be possible to apply some harmless test or indicator of free oxygen, although he confessed he did not know of any.

Mr. W. J. Dibdin said that the evolution of free oxygen might be easily detected by chemical reaction. In the presence of alkaline hyposulphite of soda, indigo was completely decolorised, but in the presence of free oxygen the indigo at once resumed its blue colour; the reaction took place with great rapidity, and testing for oxygen in this way was perfectly feasible, provided the diatoms were not injured by the medium.

The President thought there could be no doubt as to the evolution of oxygen by chlorophyll-containing vegetable organisms: this was admitted by everybody; but whether the emission of the gas was mechanically efficient in producing the motion was another matter. The somewhat crude objection might be made that so many other aquatic organisms likewise evolved hydrogen, but in the case of diatoms this process might conceivably be regulated by the peculiarities of the silicious cell-wall so as to modify the mechanical effect. He should very much like to see the sham diatoms which had been mentioned in the paper as having been constructed by the author.

Mr. Michael said the number of people who were specially diatomists, in the true sense of the term, was unfortunately becoming extremely small, and it was, therefore, not easy to obtain opinions of value concerning them, but it appeared to him that it was rather difficult to understand how the escape of free oxygen was competent to account for some of the peculiar movements observed amongst diatoms, such as vibratory movements; or how it could account for the opening and shutting of the fan-like forms which grew on a stalk. It was, however, possible that it might be effected in some way by the position of the channels through which the oxygen had to pass in escaping.

The thanks of the Society were, on the motion of the President, unanimously voted to Mr. Jackson for his communication.

The President said they had upon the table an interesting exhibition of Oribatidæ, and as Mr. Michael, who had originally presented the specimens to the Society, was present, he would no doubt be able to say a few words in reference to them.

Mr. A. D. Michael said he had been rather surprised to hear that there was to be an exhibition of slides which he had presented to the Society about twenty years ago. He could no doubt say something on the subject, but it was not so easy to say something new, as all he knew about the subject was contained in his papers read before this Society and his book published by the Ray Society. It was a long time since that book was written, and seeing that it referred only to the specimens in one man's collection, he then thought that there would in course of time be many additions to the list of British Oribatidæ, but up to the present only one specimen had been added to it. The Oribatidæ in their adult form were rather beetle-like creatures and not specially

attractive, but in the immature form many of them were very remarkable indeed. In the nymphal form there were some which were very curious. There was a large number on the dorsal surface of which two or three concentric rings would be found bordered with handsome spines, or hairs changed not into spines but into scales with nervures running through them almost like those of a dragon-fly's wing. How these concentric rings arose was a matter of considerable interest. Like almost all other Acarina, although they were eight-legged things in their adult form the larva was almost always hexapod, a very remarkable fact, because when the embryo was forming in the egg it was clearly octopod, but it was hexapod when it emerged, and when it arrived at the nymphal stage it was octopod again; these two conditions were at one time regarded as different species. The hexapod larva being drawn upon the board, Mr. Michael showed how the process of changing the skin took place, the old skin splitting all round slightly under the edge, and the legs being drawn out; the skin of the ventral surface and that of the legs was dropped, whereas on the dorsal surface it remained adherent, so that after going through its several changes the fully grown nymph, or occasionally the adult, walked about with three or four skins on its back, with a row of spines round the edge of each. This was one of the most interesting points for observation. Another species was then drawn on the board, showing a curious chitinous process on each side of the anterior portion of the abdomen. These creatures, it was explained, were vegetable feeders, having very little means of protecting themselves, except a hard chitinous coat, so that, if attacked by a predatory insect, it would probably be seized by the leg, and its only chance of avoiding capture would be to hide its legs. On the side of the body there was a series of trenches like ridges and furrows, and in a time of danger each leg was put into one of these trenches, and the chitinous, wing-like processes of the abdomen were folded down over them. This was a feature which could not be well understood unless the creatures were seen alive. By means of further drawings on the board, the structure of a curious pair of organs situated on the cephalothorax, near to the abdomen, was explained. No one now doubted that these were sense-organs, but at first they were thought to be stigmata with protective hairs. On dissecting them out, he found that they had no connection with the trachea, and it seemed probable that they were organs of hearing; the name he had given them—pseudo-stigmatic organs—had been adopted all over Europe, but he did not know that the investigation had been carried further. As far as he knew, they did not occur outside the Acarina, and very few similar organs were known outside the Oribatidæ, but in the Oribatidæ they were almost universal, so that if they were not found upon any creature under examination, it might be presumed that it was not one of the Oribatidæ.

The President thought they were very fortunate to have Mr. Michael present that evening to give them these very interesting remarks upon a subject on which he was an acknowledged authority.

The thanks of the Meeting were cordially voted to Mr. Michael for his communication.

The Meeting was then adjourned to June 21st.

The following Instruments, Objects, etc., were exhibited:—

The Society:—An Old Microscope, by Nathaniel Adams; An Adams's Lucernal Microscope, made by W. and S. Jones, presented to the Society on January 18th, 1905, by Lieut.-Col. Tupman. The following Slides of Oribatidæ, from the Collection presented to the Society by Mr. A. D. Michael:—*Cepheus bifidatus*, nymph; *C. tegeocranus* ♀; *Damæus clavipes*; *Eremæus cymba* and nymph; *Leiosoma palmicinctum*; ditto, nymph; *Leiosoma simile* ♀; *Nothrus biverrucatus*; *N. palustris*; *N. segnis*; *N. spiniger*; *N. sylvestris*; *N. theleproctus*, nymph; *Oribata alata*; *O. alata* ♀, small variety; *O. punctata* and nymph; *Tegeocranus cepheiformis*, adult and cast natogastral skin of nymph; *Tegeocranus latus* and nymph.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Alfred Jaffe and Andrew Gifford Soutter.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST, 1905.

TRANSACTIONS OF THE SOCIETY.

V.—*On the Application of the Undulatory Theory to Optical Problems.*

By A. E. CONRADY, F.R.A.S., F.R.M.S.

(*Read April 19th*, 1905.)

THE discussions which have arisen over recent theoretical papers seem to show that the simple applications of the undulatory theory which have to bo called into requisition in the explanation of optical images are not so well and so generally known as they deserve to be; and as it seriously disturbs the continuity of a paper and leads to tiresome digressions if explanations of this kind have to be interspersed, a short collection of the principal facts may be acceptable and useful for future reference, and may also assist many in understanding and appreciating the papers and discussions referred to.

Whenever we try to get the utmost resolution out of any optical instrument by increasing the magnifying power beyond a certain moderate limit, we are confronted with facts which run counter to the theories of geometrical optics, and which can only be accounted for by taking into consideration the undulatory nature of light, i.e. by rejecting the fiction of geometrical optics according to which light consists of infinitely thin rays which can be united in points, and by applying instead the principle of interference to these problems.

It has been proved by direct experiment that light travels at a finite—though very great—speed; the phenomena of interference prove light to be of an undulatory or periodic nature, and the further phenomena of polarisation force us to assume that the vibrations are transverse ones, i.e. at right angles to the line of

progression: for the fact that polarised light behaves differently in different azimuths can only be explained by the assumption of transverse disturbances. These three experimental facts, in conjunction with some others, lead to the equation expressing light undulations, which for our present purposes may be put into the simple form

$$\text{(I)} \qquad \xi = A \sin \frac{2\pi}{\lambda} (V.t - x)$$

where ξ is the disturbance at the time t in a given point at the distance x from a fixed point. V is the velocity, and λ the wave-length of the light, whilst A, the "amplitude," introduces the brightness of the light which is proportional to the square of A. The equation shows that at any one point the disturbance at regular intervals of time $\left(= \frac{\lambda}{V}\right)$ attains a maximum value equal to A; that, having attained this value, it gradually diminishes and passes through zero; that it next assumes negative valves down to $-A$; and thence returns gradually to the maximum value $+A$.

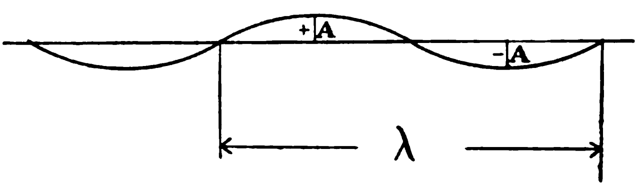

Fig. 74.

It also shows that for different values of x, i.e. for different points in the line of propagation, the disturbance is different at the same instant, and passes through the complete cycle of values for each increase of x by λ, hence the "ether-particles" at any given instant lie in a wave-line like fig. 1, and the wave propagation is equivalent to this curve travelling along at the velocity V.

When two or more such wave-motions meet, each one causes disturbances in the ether, or "displaces the ether-particles" as if the latter were at rest, and the resultant disturbance is that which follows if each wave is assumed to have moved the particles the proper amount resulting from its own equation, independently of the other waves. It will be seen that this must often lead to very complicated disturbances; but the result, as far as human eyes can realise it, may be brought under one or other of two heads, i.e. either there is some *permanent* relation between the two or more undulations that meet, and then we have the possibility of interference phenomena, or the several undulations are independent of

one another, and then their relations to each other will change with such lightning-like rapidity that the human eye cannot realise these relations separately, but receives only an average impression.

It becomes at once apparent that light from two independent points cannot have any permanent relationship when we consider that two such points may, and probably will, at any one instant be sending out light of different wave-length, which latter moreover is subject to gradual change in either point, and further, that, if we imagine ourselves looking towards any such point, the transverse vibrations may be taking place in any direction whatever across the line of sight, thus opening another source of great and changeable differences between the light from such independent luminous points. The common experience is therefore that we cannot obtain interference phenomena when light from different sources is intermingled; each source contributes its own share to the total brightness of the illumination, the latter being simply the sum of the individual *intensities*.

No formula which contains a phase-relation and which deals with *amplitudes* can therefore apply to the combination of undulations which have originated in independent sources of light, and to assign such a formula to such a purpose would clearly prove a complete unacquaintance with the elementary principles of physical optics.

The case of the combined effect of light from a number of different *independent* sources is thus settled, and nothing that follows must, or can, be applied to such a case; and as interference-phenomena thus become limited to cases where light from the same source reaches a certain point by paths of different lengths, we see that it is the study of the resultant brightness in such cases that must provide the solution of the problems of the action and resolving power of optical instruments.

Any luminous particle sends out spherical waves, and as these are the result of the vibration of the particle, we see at once that the light must at any given time and distance be performing the same kind of vibrations within a wide angular extent, and that for this reason light from a distant point must be capable of interference even though the portions brought together formed widely separated parts of a wave. This is indeed borne out by the experience with large telescope object-glasses, for in these it is found that the light from a distant star passing the different zones produces diffraction-phenomena precisely similar to those obtained with small apertures. A more difficult question is the one as to how great the difference of phase may become before the gradual changes in the rate and direction of the vibrations become manifest and prevent regular interferences. All we can say is that experience with large diffraction gratings and still more with interfero-

meters proves that differences of phase of tens of thousands and in some cases even of millions of wave-lengths do not prevent regular interference; and as in microscopical optics the differences of phase that have to be reckoned with amount at most to a few hundred wave-lengths, we need have no fears in that direction. These were the considerations which led Professor Abbe to drop * the restriction of his diffraction theory to small objects which he had mentioned in his paper of 1873, and to claim instead that his theory really applied to all objects which were seen by borrowed light, in his own words: "even to fencepoles."

We now proceed to deduce the resultant of the combination of different portions of the light from a common source when there are differences of phase between them, on the principle stated

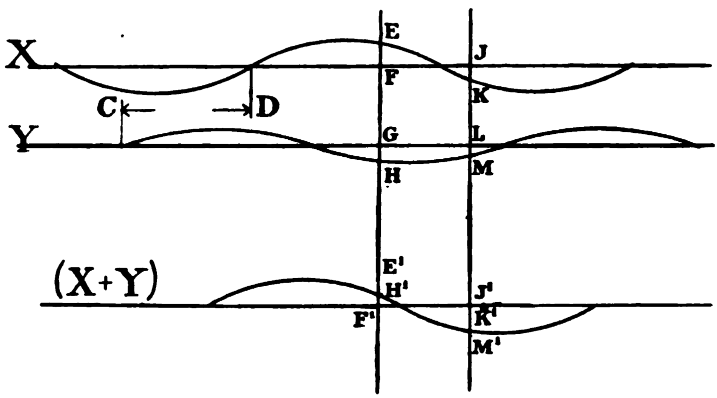

FIG. 75.

above—that the resulting disturbance is the algebraical sum of all the contributing portions. It is evident that if we can combine two disturbances, we have the means of combining any desired number by repeating the process the necessary number of times. Hence the case of two combining waves is of especial interest.

The easiest solution is a graphical one. In fig. 75 let X and Y be the two waves to be combined, the difference of phase being

* The "disclaimer" here referred to was first published by Professor Abbe in a paper of 1880, which is reprinted in "Ernst Abbe, Gesammelte Abhandungen, Jena 1904." Here, on page 290, we read: "From my present standpoint I must therefore abandon the distinction of two modes of microscopical image-formation existing side by side, and also the assumption of any kind of direct image-formation *except in the case of self-luminous objects*. Even fencepoles have their images formed *by a secondary process* after the same manner as bacteria and the most delicate diatom-structures." And there is a footnote which states: "But this is the *only* point on which I have to correct my former explanations." The italics are Abbe's, and the translation is as nearly literal as is possible.

equal to the length C—D. To obtain the resultant of the two we have merely to add the two displacements which become superposed in each point.

On the line $E—H^1$ we see that wave X has a displacement E F in the positive sense, whilst wave Y has a displacement G H in the negative sense; hence we obtain the resultant displacement by marking off $F^1 E^1 = E F$, and then from E^1 going back by the amount $E^1 H^1 = G H$. The resultant displacement here is therefore $= F^1 H^1$.

In the position $I—M^1$ the result is different, for here both combining waves have displacements in the same negative sense, hence we get a large resulting displacement $= I^1 M^1$.

By carrying out this process in a sufficient number of points, we get the result of the combination in the form of a new wave (X + Y), which differs in phase and in amplitude from the combining portions, but retains the same wave-length.

Mathematically, the solution is arrived at by bearing in mind that in our wave-equation (I) a difference of phase is expressed by a change in the value of X. If we solve the bracket in (I) we get—

$$\xi = A \sin \left\{ \frac{2\pi}{\lambda} V t - \frac{2\pi}{\lambda} X \right\}$$

For simplicity's sake we will introduce simple symbols for the two parts. The first contains the time t and is an ever-growing angle; in my paper of November 1904 I called it a, but in order to make it easier to remember that this angle involves the time, I will now and henceforth call it τ; the second angle is the difference of phase compared with that at some fixed distance from the source of light, and I will retain the symbol β for this. We may thus write two combining wave-motions as—

$$1. \qquad \left\{ \begin{array}{l} \xi_1 = A_1 \sin (\tau - \beta_1) \\ \xi_2 = A_2 \sin (\tau - \beta_2) \end{array} \right.$$

and we can combine these by solving the sines; we obtain—

$$2. \qquad \left\{ \begin{array}{l} \xi_1 = A_1 \sin \tau \cos \beta_1 - A_1 \cos \tau \sin \beta_1 \\ \xi_2 = A_2 \sin \tau \cos \beta_2 - A_2 \cos \tau \cos \beta_2 \end{array} \right.$$

and these give the sum—

$$3. \qquad \xi_1 + \xi_2 = \sin \tau \, (A_1 \cos \beta_1 + A_2 \cos \beta_2) - \cos \tau \, (A_1 \sin \beta_1 + A_2 \sin \beta_2)$$

All the quantities in brackets are independent of the time; we can simplify them by utilising a general trigonometrical theorem,

according to which it is always possible to find a quantity A and an angle β such that the equations are fulfilled—

$$4. \quad \begin{cases} A \cos \beta = A_1 \cos \beta_1 + A_2 \cos \beta_2 \\ A \sin \beta = A_1 \sin \beta_1 + A_2 \sin \beta_2 \end{cases}$$

and if we substitute these values in (3) we obtain—

$$5. \quad \xi = \xi_1 + \xi_2 = A \cos \beta \sin \tau - A \sin \beta \cos \tau = A \sin (\tau - \beta)$$

This represents a new wave of amplitude A; the value of A can be obtained by squaring equations (4) and adding them together; for the squaring gives—

$$\begin{cases} A^2 \cos^2 \beta = A_1^2 \cos^2 \beta_1 + A_2^2 \cos^2 \beta_2 + 2\, A_1\, A_2 \cos \beta_1 \cos \beta_2 \\ A^2 \sin^2 \beta = A_1^2 \sin^2 \beta_1 + A_2^2 \sin^2 \beta_2 + 2\, A_1\, A_2 \sin \beta_1 \sin \beta_2 \end{cases}$$

and remembering that $\sin^2 + \cos^2$ of any angle is equal to one, the addition gives—

$$A^2 = A_1^2 + A_2^2 + 2\, A_1\, A_2 \{\cos \beta_1 \cos \beta_2 + \sin \beta_1 \sin \beta_2\}$$

The terms in brackets represent $\cos (\beta_1 - \beta_2)$, hence we get the general solution of our problem—

$$6. \quad A = \sqrt{A_1^2 + A_2^2 + 2\, A_1\, A_2 \cos (\beta_1 - \beta_2)}$$

and having obtained A from this, we can get the phase-angle from (4), for dividing the second by the first, we obtain—

$$7. \quad tg\, \beta = \frac{A_1 \sin \beta_1 + A_2 \sin \beta_2}{A_1 \cos \beta_1 + A_2 \cos \beta_2} \,*$$

It hardly needs stating that equations (6) and (7), being a perfectly general solution, include all special cases that may occur. That they cannot, however, be applied to light from independent sources has already been laid down, and needs no further mention.

Equation (6) is identical in form with the one obtained in mechanics for the resultant of two forces; and as this is a remarkable and sometimes convenient relationship, I will briefly prove it.

Let F_1 and F_2 in fig. 76 be the two forces acting at point C, let their direction be defined by the angles β_1 and β_2 respectively which they form with some fixed direction C Z. Then it is well known that the resultant force corresponds in magnitude and direction to the diagonal C E of the "parallelogram of forces" C D E F.

* It may be pointed out that, if A is always, as is usual, given the positive sign, the quadrant in which β is to be taken must be determined by the sign of the right hand sides of equations (4) in the usual manner.

In this parallelogram we have the angle F C D = $(\beta_1 - \beta_2)$, hence angle C D E = $180 - (\beta_1 - \beta_2)$.

In the triangle C D E there are therefore known side C D = F_2, side D E = F_1, and the included angle C D E = $180 - (\beta_1 - \beta_2)$. To find the third side we apply one of the fundamental equations of plane trigonometry ($a^2 = b^2 + c^2 - 2\,b\,c \cos a$), which gives—

$$F = \sqrt{F_1^2 + F_2^2 - 2\,F_1\,F_2 \cos\{180 - (\beta_1 - \beta_2)\}}$$

but for any angle we have $\cos(180 - a) = -\cos a$, hence—

$$F = \sqrt{F_1^2 + F_2^2 + 2\,F_1\,F_2 \cos(\beta_1 - \beta_2)}$$

which becomes identical with (6) if letter F is changed to A.

If we assume the angle β between C Z and the resultant to have also been determined, the triangle C D E gives us another interesting relation, for as angle E C D = $(\beta - \beta_2)$ and angle D E C = F C E = $(\beta_1 - \beta)$, we have, remembering that $\cos(a - \beta) = \cos(\beta - a)$—

$$F = F_1 \cos(\beta - \beta_1) + F_2 \cos(\beta - \beta_2)$$

an interesting relation which may be used—when applied to amplitudes—to check the accuracy of a calculation, but which is in no sense a solution of the problem, as it requires the phase-relation between the resultant and the components to be known.

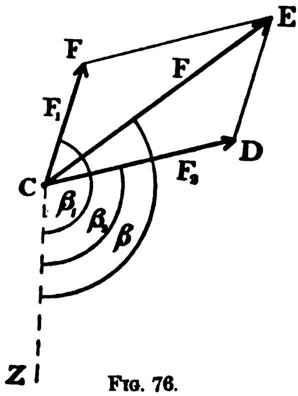

FIG. 76.

It is very important to remember when making use of this relationship between the combination of forces and that of amplitudes, that the angles β have really a totally different significance in the two cases; in the case of forces they really measure *angles* between the *direction* of forces, whilst in the case of amplitudes the direction of the disturbances is always the same (up and down in our figures), the β measuring the *difference of phase* in the sense of our fig. 75.

The formulæ (6) and (7) can easily be extended to combine any number of disturbances. The formula corresponding to (6) becomes the square root of a squared polynomial in which each double product has a corresponding $\cos(\beta_n - \beta_m)$ as factor, and the equation for $tg\,\beta$ becomes the quotient of the sum of all terms $A_m \sin \beta_m$ divided by the sum of all terms $A_m \cos \beta_m$. In concrete cases, the numerical determination is really simpler if the equations (4) with the proper number of terms have their right

sides determined numerically; the solution for A and β then becomes a very simple matter. Examples of this will probably occur in a future paper which I hope to bring forward later on.

The cases of interference which are of the most frequent occurrence, and which are of the greatest importance, are those which lead to so-called diffraction-phenomena; and a few words on problems of this kind may save many digressions hereafter, besides shedding some light on cases already dealt with in this Journal.

These cases may be stated thus:—

Light from a luminous point passes through certain apertures —wanted, the intensity and phase of the light at any point beyond those apertures.

The solution is obtained by applying the Huyghenian principle and its extension by Fresnel.

According to the former, we obtain the light-effect at any point beyond a given wave-front by considering each point in the wave-front as a new source of light, but so that all of these points are at any moment in the same phase and state of vibration, and by combining the disturbances reaching the given point from all these points of the wave-surface, according to the universal rule stated above. Fresnel extended this principle to any surface containing the diffraction apertures, whether this surface coincide with the wave-fronts or not, by stipulating that the fictitious luminous points in that surface must have assigned to them the relative phases of the direct light reaching those points, and that the combined effect at any point beyond the surface must be deduced with due regard to these phase-relations.

I will not attempt to deal with the difficulties in connection with both these principles which have been raised on theoretical grounds, nor with the way in which they have been overcome; those who are interested in that are strongly recommended to look the subject up in Drude's "Theoretical Optics." * Suffice it to state, that these investigations justify the applications of those principles which are here dealth with.

The application of these principles which is of most interest in the theory of microscopical vision is that which leads to the explanation of the peculiar effects produced by gratings and other regular structures.

As I have dealt with this very fully from the mathematical point of view in my paper of November 1904, and in the reply to the "discussion" of that paper, I need not repeat the mathematical treatment. But it may be once more insisted upon that in all these cases the result of the interference-phenomena is completely characterised by the resulting *amplitude*, i.e. the *maximum* dis-

* Drude, "Theory of Optics," translated by C. R. Mann and R. A. Millikan. …ns, Green and Co., 1902.

placement peculiar to the diffracted waves, or, briefly, the magnitude of their *elongation*, and by the relative phase, which latter is expressed either by the value of the *phase angle*, or else by the *sign* of the computed *amplitude*; the angle τ, or a in my previous communications, merely expresses the undulatory nature of the phenomena, but does *not* affect either the intensity or the *relative* phase of the light. The idea that its presence in a formula must cause embarrassment could only occur to one totally devoid of mathematical instinct.

But the application of the graphical method to this problem may be of considerable interest to those who cannot or will not study a mathematical proof.

The principal result of the mathematical investigation referred to was that diffraction-spectra from plane gratings have either the same or else the opposite phase of that simultaneously existing in the direct light, and this can be shown graphically in the following manner.

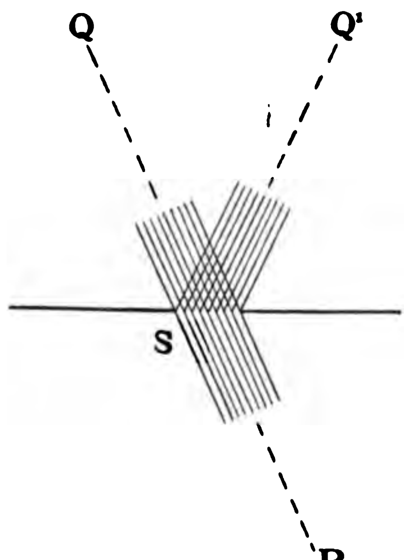

FIG. 77.

It is desired to determine the amplitude and phase of the light reaching Q¹ from a slit S (fig. 77) lighted from a distant point P, the amplitude to be compared with that which would obtain at point Q at the same distance from the slit as Q¹, but in a direct line with P, and the phase to be referred to that which light from the centre of the slit would produce at Q¹.

Both P and Q, being at a distance which is assumed to be great, as compared with the width of the slit, all the light will reach Q in the same phase, and we shall, therefore, get a resulting amplitude at Q, which is the simple sum of all the disturbances proceeding from the slit. But otherwise at Q¹. For here we have obvious differences of the paths, by which light from P through the different portions of the slit, reaches Q¹; hence there will be more or less weakening of the light at Q¹ through interference. If we now divide our slit into a number of equal parts so narrow that the light from any one part may be assumed to reach Q¹ in the same phase, we shall be able to combine the light from these parts *in pairs* by the simple process shown in fig. 75. Such a pair close to the centre will have an inappreciable difference of phase, and

we shall get a resulting amplitude nearly equal to the simple sum of the two (fig. 78, *a*). But if we take a pair with a considerable difference of phase, one being behind, the other an equal amount in front of the light from the centre of the slit, then there will be

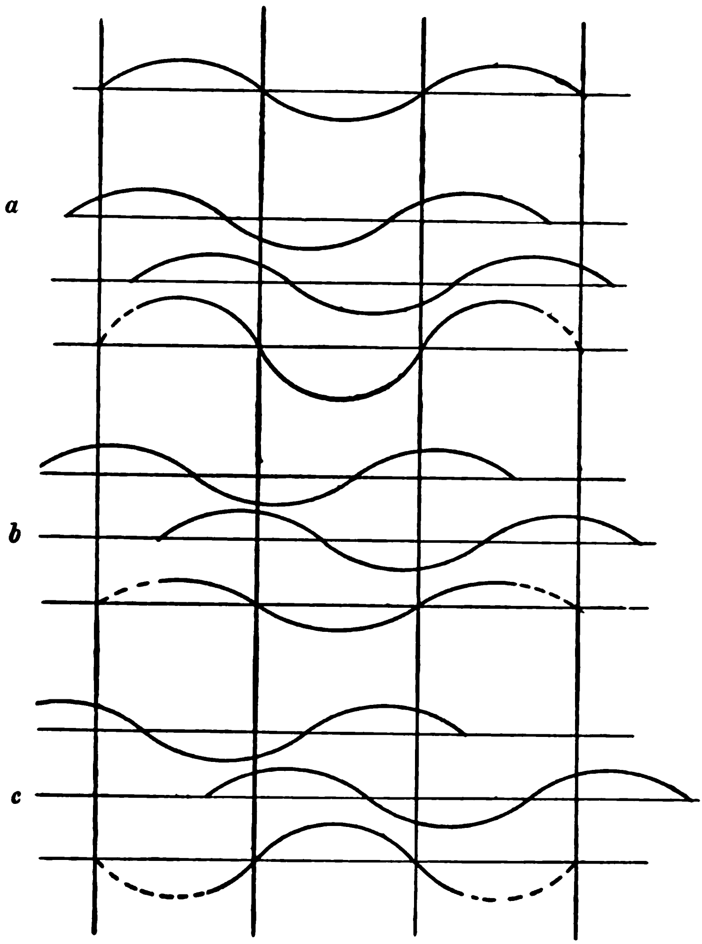

Fig. 78.

interference. And an inspection of fig. 78, *b*, immediately shows a striking peculiarity; for as one wave-curve recedes just as much from any of the nodes of the central light as the other exceeds it, the displacements of the two waves at those nodes must *always* be equal to each other, but in opposite directions; on the principle of

combination illustrated in fig. 75 and again here, *the two waves will, therefore, invariably produce a node in the same position as light from the centre of the slit.* In fig. 78, *b*, there results a small combined wave still in the same sense as that from the centre. But proceed to fig. 78, *c*, where the difference of phase of either wave is more than ¼ wave-length as compared with the wave from the centre of the slit. We still get the same position of the nodes, *but these two waves produce a resultant wave of the opposite character to that of the wave from the centre of the slit,* and this shows graphically what I proved mathematically in my paper.

If we apply this process to all the successive pairs and then combine the resultants of these, we shall get the complete result; without going into the details, it may be pointed out that if the differences of phase between the extreme edges of the slit and its centre do not exceed ¼ wave-length, all the resultants are in the same sense, and reinforce each other; for a wider slit, the pairs further removed from the centre combine to the opposite effect—hence the total light is weakened, and eventually becomes zero when the edges of the slit are ½ wave-length out of phase compared with the centre. With still wider slits the light reappears, *but in the opposite phase,* in the manner described in my paper.

NOTES.

The Tubercle Bacillus.

By Edward M. Nelson.

Twenty-four years have now passed since the publication by Dr. R. Koch of his discovery of the tubercle bacillus. He differentiated it from its surrounding material by staining it with methylen-blue and vesuvin. He described the bacilli as being very small rods, in length about $\frac{1}{3}$ the diameter of a red blood corpuscle, and in breadth about $\frac{1}{8}$ of their length.* In the same year these rod-shaped organisms were resolved by me into beaded structures.† At that time, owing to the imperfections of the staining method, the beading on these bacilli was very difficult to demonstrate; but shortly after a new method of staining was introduced by Dr. Ehrlich (Dr. Koch's assistant) which enabled the organisms to be seen with a dry lens.‡ Ehrlich's method was further improved by Dr. H. Gibbes,§ and so distinct were the bacilli in his preparations that I was able to bead them with a $\frac{4}{10}$ objective.

An average specimen of this organism as prepared by Dr. Koch was in appearance like a row of rounded beads, eight in number, but in a preparation by Dr. Gibbes there would only be four beads; they would, however, be larger and more widely separated; so that on the Koch's slide they would count 70 to 80, and on the Gibbes' slide 35 to 40 in one-thousandth of an inch; therefore beads which were difficult to demonstrate on a Koch's were easy to see on a Gibbes' slide. This may be explained by supposing that an average specimen of the tubercle bacillus consists of four cells, and that with Koch's method the stain only enters the ends of the cells, leaving the centres unstained, while in Gibbes' preparations only the central portion of the cell is stained. Fig. 79 shows a bacillus stained by Koch, and fig. 80 one by Gibbes; in fig. 79 the edges of the cells, and in fig. 80 the edges and divisions between the cells, have been inserted to illustrate the above supposition.

Further improvements in the technique of staining were made, notably by Mr. J. C. Pound, F.R.M.S., who in 1889 prepared some

* Verh. Physiol. Gesell. Berlin, 1882, p. 65; Lancet, 1882, pp. 655–6; J.R.M.S. 1882, pp. 385–8; Naturforscher, xv. 1882, pp. 149–50.

† Eng. Mech., xxxv. (1882) p. 378 (2 figs.).

‡ Bull. Soc. Belg. Micro., vii. (1882) pp. cxvii.–cxxii.; Berl. Klin. Wochenschrift, May 6, 1882: J.R.M.S., 1882, pp. 572–4.

§ Lancet, 1882, ii. pp. 183–4; Brit. Med. Journ., No. 1137 (1882) pp. 735–6; J.R.M.S., 1882, pp. 895–7, and 1883, pp. 764–5; Lancet, 1883, i. p. 771.

very beautiful slides. The beads appeared much more elongated; and there was distinctly less distance between bead and bead; in brief, it was evident that the cell contents were being more perfectly stained.

Quite recently further improvements in the methods of staining have permitted a still better picture of the bacillus to be obtained, as fig. 81 illustrates.

A unit cell now appears to be square ended, showing that its contents have been pretty fully stained, the apparent distance between one cell and the next is much reduced, and the whole bacillus looks something like a jointed bamboo; the resolution of these joints has now become more difficult, and can no longer be performed by quite low powers. At one end a flagellum is seen; this flagellum is very similar both in its appearance and also with regard to its visibility, to that of the cholera bacillus, which I figured in the "British Medical Journal" for May 1885, p. 878.

FIG. 79.

FIG. 80.

FIG. 81.

Only a single flagellum is seen in fig. 81; there were many similar examples on the slide, but it is only after some searching that a bacillus with a visible flagellum can be found. It requires, however, a very formidable search to find one with a flagellum visible at both ends. On one specimen I thought I glimpsed a second flagellum, and perhaps also on another besides, but an example thoroughly typical of many others on the slide was selected for illustration. The preparation was of sputum from a phthisical patient.

The specimen in fig. 81 is of average size.

Length without flagellum $\frac{1}{8600}$ in. $= 2 \cdot 94\ \mu$
" of flagellum . $\frac{1}{20400}$ " $= 1 \cdot 24$ "
" of one joint . $\frac{1}{35600}$ " $= 0 \cdot 71$ "
Breadth . . . $\frac{1}{73900}$ " $= 0 \cdot 34$ "

The joint measured is one of the larger ones.

The W.A. was $0 \cdot 95$, the length corrected for antipoint* is, therefore, $\frac{1}{8400}$ in. $= 3 \cdot 03\ \mu$, and the breadth $\frac{1}{57300}$ in. $= 0 \cdot 44\ \mu$.

The figures are drawn with a magnification of 5000 diameters.

Since this was written many tubercle bacilli with a flagellum at each end have been observed.

* J.R.M.S., 1903, pp. 579–82, and 1904, p. 271.

The Ashe-Finlayson "Comparascope."

(An instrument to facilitate comparisons being made between different objects by projecting their images together into the field of the Microscope.)

By D. Finlayson, F.L.S.

The desirability of some method whereby two objects may be simultaneously examined in the same field of view, is often experienced by microscopists and analysts, especially by those who are engaged in work which necessitates frequent comparisons being made between objects which present very similar appearances.

It seems strange, therefore, that no attention, so far as can be ascertained, has hitherto been directed towards the construction and perfecting of apparatus to serve this purpose.

In examining objects of a totally different appearance and structure, the use of such an adjunct would be obviously unnecessary—in fact, its employment would be a positive disadvantage, by its limiting the area of the object seen to one-half of the field of view; but when the differences of structure or variations of form are too slight to be readily perceived, then the ability to place by instrumental means the subject to be examined, and the standard by which it is to be compared, side by side, in the same field, is an advantage so great that its value need not be dwelt upon.

The purpose in view could be carried out most effectively by the construction of a complete Microscope specially built for the purpose, but as such an instrument would necessarily be expensive, and limited in the scope of its general utility, it seems desirable to confine the problem to the construction of an apparatus which can be used as an adjunct to, and in conjunction with any existing type of Microscope, of which it should not require the alteration or special adaptation of any part, nor interfere with its use as an ordinary instrument when required.

The device now described (fig. 82) fulfils these conditions in a manner that promises complete success.

The construction is based upon the fact that if an objective be placed at right angles to the axis of a Microscope, any rays of light passing through it may be deflected up the tube to the ocular by means of a mirror placed at a suitable angle, and that any object in the focus of the secondary objective will be seen simultaneously with the image produced by the direct rays from the primary objective.

Two images will thus be transmitted to the ocular, and appear superimposed upon each other, and consequently blurred.

To prevent this overlapping and confusion of images, it is necessary to confine each set of rays to one side of the tube and one segment of the field of view. This is accomplished by inserting into the draw-tube a removable diaphragm or division plate,

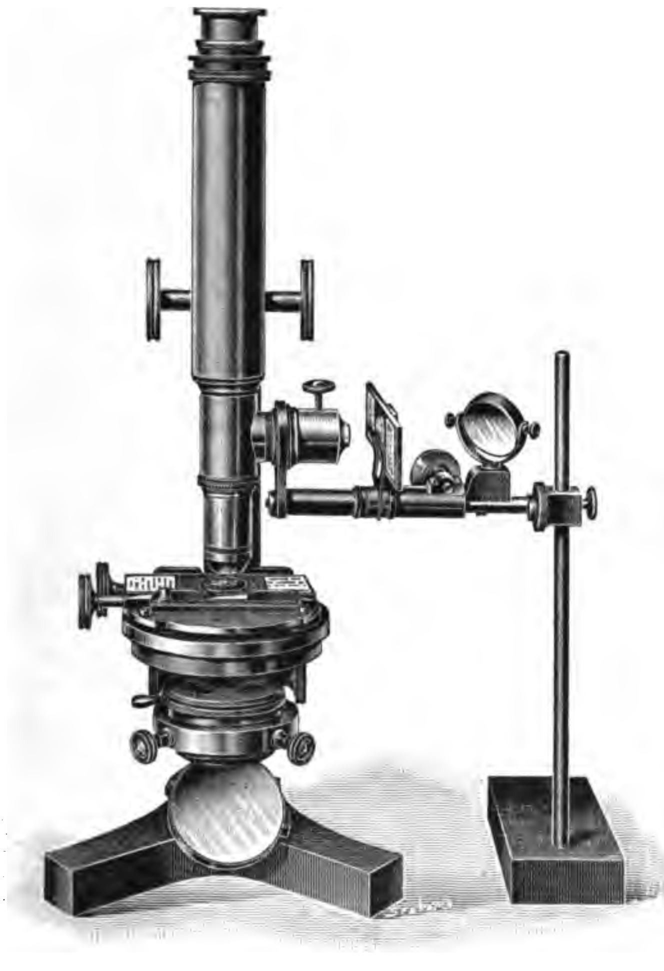

Fig. 82.

which extends from the fitting containing the reflector to within an inch or so of the ocular, the tube thereby being divided into two semi-cylindrical sections, each of which transmits rays from a different object, and the image of which will occupy separate segments of the field of view.

The instrument is the joint invention of Messrs. Ashe and Finlayson, and was designed to suit the special requirements of the latter in his examination and comparison of food materials, meals, starches, and fibres; also for use in the medical profession for those engaged in research work, such as the comparison and identification of bacteria and disease germs of every kind. Hence the name "Comparascope," which has been given to the invention.

It consists of a vertical pillar fixed in a heavy case. To this pillar is clamped at any required height a horizontal bar, which carries at one end an objective, and at the other a mirror capable of universal motions, whilst between the two there is a stage or slide-clip, which traverses the bar by a rack-and-pinion movement for focussing purposes, as the position of the objective is required to be a fixture.

On the nose-piece of the Microscope is screwed a fitting consisting of a tube an inch long, with a hole in the middle of one side. Inside this aperture is fixed a reflector of tinted glass, worked to a perfect plane on its upper surface. It is placed at an angle of 45° to the axis of the tube, beyond which it does not extend, in order to allow free passage for the light from the primary objective.

A prism might be employed, but a reflector is more simple—in fact the inventors in their early experiments used a Becks' vertical reflector, with a prism turned to project the light upwards instead of downwards, and they found the result was quite satisfactory.

For use with high powers and wide-angled lenses a condenser will necessarily have to be employed to illuminate the secondary objective, and this is best effected by attaching a condensing system to the movable stage, instead of giving it independent movement on the same bar.

In use the instrument is very simple, and there is no difficulty in getting the fields equally illuminated, and if the lenses are duplicates, the definition and magnification should be the same.

*An Optical Paradox.**

By Lord Rayleigh, O.M., F.R.S.

Consider the following combination:—A point source A of approximately homogeneous light (λ) is focused by the lens LL upon the object-glass of a telescope T. In its turn the telescope is focused upon L. According to geometrical optics the margin of the lens L should be seen sharp by an eye applied to the telescope; but when we consider the limitation of aperture at the object-glass of the telescope, we come to the conclusion that the definition must be very bad. The image of A at C constitutes the usual diffraction pattern of which most of the light is concentrated in the central disc. The diameter of this disc is of the order $\lambda . \mathrm{LC}/\mathrm{LL}$. If this be regarded as the effective aperture of T, the angular resolving power will be found by dividing λ by the above

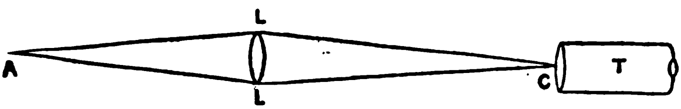

Fig. 83.

quantity, giving LL/LC; so that the entire angular magnitude of the lens LL is on the limits of resolving power.

If this be admitted, we may consider next the effect of enlarging the source A, hitherto supposed to be infinitely small. If the process be carried far enough, the object-glass of T will become filled with light, and we may expect the natural resolving power to be recovered. But here we must distinguish. If the enlarged source at A be a self-luminous body, such as a piece of white-hot metal or the carbon of an electric arc, no such conclusion will follow. There is no phase-relation between the lights which act at different parts of the object-glass, and therefore no possibility of bringing into play the interferences upon which the advantage of a large aperture depends. It appears, therefore, that however large the self-luminous source at A may be, the definition is not improved, but remains at the miserably low level already specified. If, however, the source at A be not a real one, but merely an aperture through which light from real sources passes, the case may be altered.

Returning to the extended self-luminous source, we see that the inefficiency depends upon the action of the lens L. If the glass

* Reprinted by permission of the author from Phil. Mag., June 1905, pp. 779–81.

be removed from its seat, so that A is no longer focused upon the object-glass, the definition must recover.

I do not know how far the above reasoning will seem plausible to the reader, but I may confess that I was at first puzzled by it. I doubt whether any experimenter would willingly accept the suggested conclusion, though he might be unable to point out a weak place in the argument. He would probably wish to try the experiment; and this is easily done. The lens L may be the collimating-lens of an ordinary spectroscope whose slit is backed by a flame. The telescope is removed from its usual place to a distance of say 10 feet and is focused upon L. The slit is at the same time focused upon the object-glass of the telescope. Although the image of the slit is very narrow, the definition of L as seen in the telescope does not appear to suffer, the vertical parts of the circular edge (parallel to the slit) being as well defined as the horizontal parts. If, however, at the object-glass a material screen be interposed provided with a slit through which the image of the first slit can pass, the definition at the expected places falls off greatly, even although a considerable margin be allowed in the width of the second slit.

This experiment gives the clue to the weak place in the theoretical argument. It is true that the greater part of the light ultimately reaching the eye passes through a very small area of the object-glass; but it does not follow that the remainder may be blocked out without prejudice to the definition of the boundary of the field. In fact, a closer theoretical discussion of the diffraction phenomena leads to conclusions in harmony with experiment.

In the case of a point-source and the complete circular aperture LL, the question turns upon the integral

$$\int_0^\infty J_0(\alpha x)\, J_1(\beta x)\, d x,$$

J_0, J_1 being the Bessel's functions usually so denoted. The integral passes from 0 to $1/\beta$, as α passes through the value β *.

If the aperture of LL be reduced to a narrow annulus, the integral to be considered is

$$\int_0^\infty J_0(\alpha x)\, J_0(\beta x)\, x\, d x.$$

This assumes an infinite value when $\alpha = \beta$ †.

If the apertures be rectangular, the integrals take still simpler forms.

* A theorem attributed to Weber See Gray and Matthews' "Bessel's Functions," p. 228.

† See "Theory of Sound," § 203, equations (14). (16).

New Hot Stage.

By W. S. Lazarus-Barlow, M.D., F.R.C.P.

Plate VII.

The inventor exhibited and described at the June Meeting a new form of warm stage, which can be heated by either gas or oil. The principle of the apparatus is that of a balance and a manometer combined. The stage itself is a brass box, which contains a series of flattened and communicating glass bulbs, connected with a mercury manometer of particular shape. A glass tap is fused into the manometer between it and the stage itself. Over the mercury in the open limb of the manometer is an iron float, suspended by silk from one arm of the beam of a balance. This beam is supported on a knife-edge, and is provided with an adjustable weight at the end distal from the warm stage, and a silver rod suspended by loops of platinum-iridium at the proximal end. The silver rod is bent downwards at one end, and is placed at right angles with the beam, both being in the horizontal plane. The bent portion of the silver rod dips into a small bath, which is brazed to the side of the warm stage, and contains paraffin of M.P. about 58°.

The apparatus works as follows. Heat from a flame is applied to the silver rod at the unbent end, and is conducted to the paraffin in the bath at the side of the stage, and thence to the stage itself. Variations in the temperature of the stage are conveyed to the air in the glass bulbs within the stage, and express themselves by expansion or contraction of that air, and therefore by variations in the level of the mercury in the manometer. These variations of the level of the mercury allow the entire weight of the iron float in the distal limb of the manometer to act upon the beam (when the mercury recedes sufficiently to lose contact with the float), or remove the entire weight of the float from the beam (when the mercury rises sufficiently to slacken the silk thread connecting the beam and the float). Intermediate positions of the mercury, of course, allow intermediate proportions of the weight of the float to act upon the beam. Hence the weight on the side of the beam towards the warm stage varies inversely as the volume of the air within the glass bulbs, i.e. inversely as the temperature of the stage itself. Consequently (the beam being free to move about its fulcrum) the cooler the stage the deeper the heated silver rod is plunged into the bath of paraffin, and *vice versâ*; this greater immersion of the heated silver rod heats the stage, expands the air in the bulbs, raises the mercury in the distal limb of the manometer, supports the iron float, and allows the beam to revert to its original horizontal position—or

even become somewhat tilted in the opposite direction—with the result that less heat is given to the stage, the stage cools somewhat, and the cycle of events re-commences.

It will have appeared from the last paragraph that the construction of the beam and its component parts is of some importance. The beam itself is made of magnalium — a newly-discovered alloy of magnesium and aluminium, which is rigid and of low specific gravity—in order to re-act readily to slight variations in weight at either end. In commencing work, the beam is so adjusted by means of the adjustable weight and the silk thread attached to the float, that when the entire weight of the float is acting the beam is inclined downwards towards the stage, and the bent portion of the silver rod is well immersed in the paraffin; when the iron float is supported, the inclination of the beam is such that the silver rod is just above the level of the paraffin, and when the float just touches the surface of the mercury, the beam is horizontal.

Having arranged the beam satisfactorily, the glass tap connected with the glass bulbs is turned full open, and heat is applied to the silver rod. As soon as the desired temperature has been reached, as indicated by a thermometer inserted in one side of the stage, the glass tap is turned off, and the oscillations about that temperature commence. The stage shown had been kept at a temperature not varying more than 1° on either side of 100° F. day and night for a week.

In describing the apparatus (fig. 84, pl. VII.) the author referred to many difficulties met with during its evolution, and particularly that dependent upon the existence of an irregular expansion of copper about the temperature of 100° F. It was this which necessitated the employment of glass bulbs to contain the air, instead of allowing the stage itself to act as the air-containing closed box connected with the manometer.

The Bunsen burner for the apparatus is of a new model, being provided with a safety cock for shutting off the gas in case of accidental "firing back." This cock is situated close to the base of the burner on the horizontal tube, and is provided with a long arm, to which a spring is attached. This arm is soldered with soft solder to the bottom of the vertical tube of the burner, and in this position the gas is full on and the spring is stretched. If the Bunsen fires back, the lower part of the burner becomes rapidly heated, the solder melts, and the recoil of the spring turns the cock and shuts off the gas.

The author acknowledged the great help he had received in the preliminary stages from Mr. W. T. Hillier, M.R.C.S., his former assistant in the Cancer Research Laboratories of the Middlesex Hospital, and from Mr. Swift, of Tottenham Court Road, who made the finished apparatus from rough models and drawings.

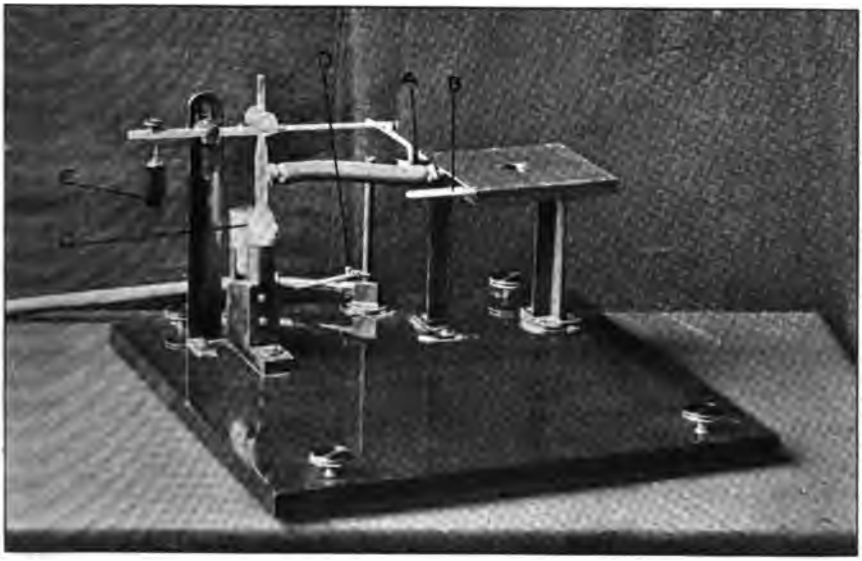

FIG. 84.

A. Points to the paraffin bath brazed to the stage, into which dips the bent end of the silver heat-conducting rod.

B. The thermometer.

C. The manometer, with its glass tap on the limb (nearer the observer), and its open limb, over which hangs the iron float (further from the observer).

D. The spring safety cock attached to the gas supply of the Bunsen burner.

E. The adjustable weight at the distal end of the beam.

[To face p. 420.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Ovarian Eggs of Guinea-pig.‡ — L. Loeb discusses very fully a number of points relating to the ovarian egg, such as the oocytes of the medullary strands (Markstränge) of the ovary, follicle atresia, and the progressive changes in the eggs. He found that in 10 p.c. of the ovaries of guinea-pigs of less than six months, follicle-like bodies with plasmodia and syncytia were present. Other cells near the centre of the follicles had a cylindrical or cubical form. Of ninety-eight ovaries, mostly older, only one possessed such a follicle-like body. They are probably unruptured follicles in atresia. In the neighbourhood of these formations similar alterations of ovarian tissue are traceable in different directions; they appear to be in the course of the blood and lymph vessels. Various transformations of these bodies are described; they finally degenerate, and are destroyed by the ingrowth of connective tissue. Oocytes in all stages of development were found in the "medullary canals" of the ovary of the young guinea-pig. They never show progressive alterations, and do not reach the size of the matured egg, but degenerate early and leave behind them an often thickened membrana pellucida. The canal may alter cystically, and the cysts may reach a considerable size. In the ovary mitoses may occur in segmented egg-cells, and two contemporaneous mitoses may be found in two distinct segments. The author looks upon this as the beginning of a parthenogenetic development which soon comes to an end. Various mechanical and chemical stimuli failed to induce progressive alterations in the ovarian egg.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This Section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Arch. Mikr. Anat., lxv. (1905) pp. 728–53 (1 pl.).

Follicles and Egg-envelopes of Belone acus.* — S. Comes has studied the question of the functional nature of the follicles and the differentiation of the egg-envelopes in *Belone* with the following results. He finds that the vitelline membrane appears double in the mature egg; the interior portion rests upon a vitelline layer differentiated from the rest of the vitellus. The follicle secretes at the appearance of the eggs of the second category (classification of Van Bambeke) a special mucus which condenses and becomes the chorion. This structure in mature eggs is two-layered, the outer stratum giving rise to the filaments of the egg.

Nucleolar Dissolution.†—A. Cerbuti discusses the nucleinic nucleoli which he has observed in the oocytes of Selachians and the wall lizard, and in Bidder's organ in the toad. He thinks they may be associated with complicated "nucleolar resolutions," such as Carnoy and Lebrun have described in the nucleoli of the oocytes of Batrachians. They have a short duration and are dissolved into granules, but they may give rise to new nucleoli.

Experimental Researches on Egg of Rana fusca.‡—A. Brachet finds that in *Rana fusca* the structure and constitution of the fertilised egg is fixed in the sense that the germinal substance is divided symmetrically on each side of a vertical plane. This plane determines the place of origin of the primitive embryonic organs. Whatever the orientation of the first plane of segmentation in relation to the plane of bilateral symmetry of the egg, it is maintained integrally during the whole course of development. All parts and all primitive organs of the embryo are built up *à l'endroit* and at the expense of the materials fixed for them by the material and dynamic constitution of the whole egg. The destiny of the first blastomeres depends in normal—and in some experimental—conditions, not upon their connections or their reciprocal influence, but upon the place they occupy in the unsegmented egg, since on this place depends the quality of the germ material and its energies.

Motion of Spermatozoa.§—H. Adolphi has observed the movements of the spermatozoa of man, sheep, and ox, has timed the rapidity of their swimming, and has noticed, as Lott did for dog, and Hensen for guinea-pig, that they move persistently against the current. Thus they are the better able to pass upwards from the vagina in spite of opposed ciliary activity.

Structure and Movements of Spermatozoa.‖—A. Roth argues that there are mechanical reasons for the way in which spermatozoa persistently move against a current. Even under a cover-glass, when a current is induced by blotting-paper at one end, the spermatozoa all arrange themselves with the head against the current. The author maintains that all spermatozoa have a spiral structure which effects this orientation.

* Anat. Anzeig., xxvi. (1905) pp. 9–17. † Tom. cit., pp. 613–22 (16 figs.).
‡ Arch. Biol., xxi. (1904) pp. 103–60 (1 pl.).
§ Anat. Anzeig., xxvi. (1905) pp. 549–59 (2 figs.).
‖ Arch. Anat. Physiol. (Physiol. Abth.) 1904, pp 366–70. See Zool. Zentralbl. xii. (1905) pp. 158–9.

Accessory Nuclear Structures in Spermatozoa.*—G. Retzius finds in the spermatozoa of Polychæts and Molluscs peculiar spherules which lie at the posterior end of the head. They are definite in number, and regular in arrangement. He calls them accessory nuclear organs, and compares them to the mitochondrial body.

Influence of Ovariotomy in Goat.†—P. Oceanu and A. Babes find that the removal of the ovaries has the following advantages:—(1) the hircine odour of the milk disappears, (2) the duration of lacteal secretion is increased, (3) there is fattening and an improvement in the quality of the flesh, (4) the quantity of milk is increased, and (5) the quantity of butter, casein and phosphoric acid is increased, while that of lactose is decreased.

Influence of Nervous System in Regeneration.‡—E. Godlewski has made many experiments on newts which lead him to conclude, like Rubin and G. Wolff, that the presence of the central nervous system is absolutely essential to the normal course of regeneration. The spinal ganglia cannot replace the formative influence of the spinal cord centres in instituting the regenerative process. A breach of continuity in the central nervous system has no influence on the normal course of regeneration. The presence of the central nervous system conditions the activity of the prospective potencies of those elements which are stimulated by an operative effect to the realisation of their regenerative capacity.

Regeneration of Limbs in Tadpoles of Frog.§—A. Bauer finds that the regenerative power decreases with age; that it is more effective when the amputation is near the distal end; and that it may be exhibited twice or three times in regard to the same limb. There seems to be a considerable difference in the regenerative power according to the time of birth, for it is much more intense in young tadpoles hatched in April than it is in those of July. In the latter there is a marked enfeebling of the "biogenetic activity" throughout the tissues, as shown in the retardation or the arrest of development. Thus the regenerative power may be a function of the power to accomplish metamorphosis.

Origin of Subclavian Artery in Chick.‖—C. G. Sabin finds that in the chick the earliest circulation to the wing region (from the third to the sixth day) is derived from the dorsal aorta, and that the main vessel of this circulation corresponds to the sub-clavian in mammals. A secondary wing circulation derived from the ventral end of the third arch, not existing previous to the sixth day, is at that time established, and both vessels carry blood to the wing for a time. Further, at some time in the latter part of the seventh day, or the first part of the eighth, the primary vessel atrophies and disappears, while the ventral artery increases in size and develops into the adult condition of the subclavian.

Origin of Lungs.¶—Alfred Greil objects to the view of Goette, Spengel, and others, that the lungs may be traced to posterior (sixth)

* Anat. Anzeig., xxv. (1904) Ergänzungsheft, pp. 154–6.
† Comptes Rendus, cxl. (1905) pp. 172–4.
‡ Bull. Internat. Acad. Sci. Cracovie, 1904, pp. 492–505 (1 pl.).
§ Journ. de l'Anat. Physiol., xli. (1905) pp. 288–99 (22 figs.).
‖ Anat. Anzeig., xxvi. (1905) pp. 317–32.
¶ Tom. cit., pp. 625–32 (5 figs.).

branchial pouches, and brings forward new arguments in support of the view that lungs are homologous with the swim-bladder.

Lens Formation in Frog.*—H. Spemann removed the primary lens-forming cells, with a view to discover whether the lens and cornea are formed independently of the nervous part of the eye. Retinal influence was found necessary, but it was not determined whether the primary lens-forming cells are differentiated as such before the cells of the eye-cup use them in lens-formation.

Early Stages of Pleuronectes cynoglossus.†—H. C. Williamson describes a series of post-larval and early stages of *P. cynoglossus*. There is a long post-larval period, and a large size is reached before the bottom habitat is adopted. Sketches are given which ought to aid in the diagnosis of preserved examples.

b. Histology.

Hydraulic Theory of Ciliary Action.‡—E. A. Schäfer describes simple models which he has devised to illustrate ciliary action. The conclusion to which a study of these models leads him, is that the theory of the action of a cilium which assumes that the movement is caused by the inflow and outflow of fluid, or, in other words, by the increase and diminution of the fluid pressure, within a simply or spirally curved, hollow extension of the cell, is adequate to explain the phenomenon, and in the absence of any other physically possible theory, may be provisionally adopted.

Interconnections of Epidermal Cells.§—L. Merk brings forward evidence to show that there is more than mechanical connection between the epidermal cells of the human skin, both *inter se* and with the subjacent corium. They are attached to one another like the eggs and their gelatinous envelopes in frogs' spawn. They are attached to the corium as a drop of sputum to the surface to which it clings.

Regeneration of Nerves.‖—Oskar Schultze concludes that the processes of regeneration in peripheral nerves agree with those of ontogenesis. The peripheral nerve arising from its special energids has the power of repairing a defect by means of these same elements, namely the peripheral neuroblasts, the nuclei of which are the so-called Schwann's nuclei. The regeneration of a peripheral nerve is not merely autogenous, it is also isogenous, like that of epithelium, gland, or muscle. The nerve grows and regenerates itself like a muscle. It seems from the pathological results also that the neuron-theory must be given up. The peripheral fibre is no cellular process with apposed ensheathing cells; it is a syncytium with innumerable "trophic" and regenerative centres proper to itself. If there is a hole made in the syncytium, the surfaces of the wound seek to close it up from both sides. If the hole

* Zool. Anzeig., xxviii. (1905) pp. 419–32.
† Rep. Fishery Board, Scotland, 1904 pp. 270–4.
‡ Anat. Anzeig., xxvi. (1905) pp. 517–21 (2 figs.).
§ SB Akad. Wiss. Wien, cxii. (1903) received 1905, pp. 399–412 (1 pl. and 1 fig.)
‖ Verh. Phys. Med. Ges. Würzburg, xxxvii. (1905) pp. 267–96 (10 figs.).

remains the peripheral portion dies, for lack of the stimulus coming from or going to the centre essential to its continued life.

Ganglion Cells of Cerebellum of Pig.*—K. Takasu has studied the development of these in the cortex of the cerebellum. The Golgi cells and basket-cells appear clearly only in a embryo of 195 mm., and grow steadily to the end of embryonic life. The Purkinje cells are distinguished from all other cells in the earliest stages only by the brightness of their relatively large nucleus. Only in embryos of from 132–150 mm. do they possess much protoplasm, and from this stage they grow rapidly. In the later stages their branched processes develop a finely striped tigroid substance. The development of the ganglion cells in the interior of the medullary mass is always further advanced than that of the Purkinje cells. Medullated nerve fibres in the medullary layer, and in the inner granular layer, appear first in embryos of 220 mm.

Central Nervous System of Torpedo.†—M. Borchert describes certain hitherto unknown peculiarities in the manner of exit of those cranial nerves which have clearly separated anterior and posterior roots. The anterior roots uniformly join the posterior on their ventral side. In the case of the lateral nerves of the trigeminus-facialis-acusticus-complex, and also in the trigeminus and facialis, the anterior root joins first the medial and then the ventral side of the posterior.

Structure of Red Blood Corpuscles in Amphibians.‡—Fr. Meves discusses in the first place the reticular structure which is certainly demonstrable in the red blood corpuscles of the frog, though many appearances so described are artefacts. He then discusses the granular inclusions, e.g. the "chromatoid" spherules; the alleged occurrence of two concentric zones, which he regards as artificial; and the alleged presence of an external membrane, which he denies.

Structure of Erythrocytes.§—E. A. Schäfer gives detailed evidence to show that the erythrocyte, both in mammals and in oviparous vertebrates, is a vesicle consisting of a thin membrane enclosing fluid contents. The membrane of the erythrocyte is composed of a soft, yielding, elastic material, mucus-like in consistence and chemically resembling protoplasm; containing nucleo-proteids, lecithin and cholesterin in almost the same relative amount as protoplasm. He calls attention to the important observations of Norris, which have been unjustly ignored. Norris not only proved that the blood corpuscles must be regarded as invested by a surface film of a material not miscible with water, but also concluded for the myelinic nature of that film, and ascribed to this the flattened form of the corpuscle.

Absorption of Fat by Chorionic Villi.‖—J. Hofbauer discusses the minute structure of the chorionic villi, and the evidence which shows that fat is taken into the villus-syncytium under conditions

* Anat. Anzeig., xxvi. (1905) pp. 225–32.
† Tom. cit., pp. 289–92. ‡ Tom. cit., pp. 529–49.
§ Tom. cit., pp. 589–600.
‖ SB. Akad. Wiss. Wien, cxii. (1903) received 1905, pp. 204–29

similar to those which obtain in the case of the intestinal epithelium. The protoplasm of the cells does not remain passive in relation to the surrounding medium, but actively regulates the absorption of fat globules. Fat coloured with sudan was traced from the maternal alimentary system to the fœtal blood.

Crystalloids in Amphioxus.*—H. Joseph finds in the epidermal cells of *Amphioxus* peculiar "crystalloids" in the form of granules or of rods which often fill the whole cell.

Tentacle Apparatus of Dactyletra calcarata.†—L. Cohn has made a detailed study of the tentacles in this anourous amphibian. They occur one below each eye, are differently developed in different species, and have been used accordingly in species diagnosis. When the tentacle is extended an end opening may be seen with the unaided eye; they are tubular, and Cohn finds that their canal is continuous with a special diverticulum of the nasal cavity. Their walls possess well developed circular muscles, and it is suggested their function may be the ejection of nasal secretion, but no definite conclusion can at present be stated.

Cytological Changes in Kidney.‡—F. Schmitter has investigated a variety of structural appearances of pathological kidney tissue. He finds that the kidney of the cat exhibits vesicles, foam-structure, imbrication, brush borders, vacuoles and canals, under different conditions of treatment by maceration in distilled water and salt solution of varying strengths.

Chromaffin Tissue in Birds.§—W. Kose has investigated this tissue in a number of birds, and gives a summary of his results on the paraganglion caroticum, the paraganglion suprarenal, the chromaffin tissue of the sympathetic, and paraganglia unconnected with the sympathetic system.

Elastic Tissue of Prostate.‖—A. Cosentino gives a full account of the distribution of this tissue in man and various mammals. On the whole there is very little variation. In the cat and dog the prostate surrounds the whole of the urethra, and the seminiferous ducts traverse the whole as in man. There is a very intimate connection between the prostate fibres and those of the urethra. In other animals the prostate only touches the dorsal face of the urethra and most of the gland is quite independent of the ejaculatory ducts and of the urethra. The only point at which there is a certain similarity of distribution of the elastic tissue in these two types is in the tract nearest to the verumontanum. The periurethral elastic fibres in the latter group at the level of the verumontanum debouch into the urethra, but in part it appears they re-enter the elastic system of the prostate. This distribution modifies the acinose structure. Numerous other details are given in the paper.

* Anat. Anzeig., xxv. (1904) Ergänzungsheft, pp. 105–12 (8 figs.).
† Zeitschr. wiss. Zool., lxxviii. (1905) pp. 620–44 (1 pl.).
‡ Anat. Anzeig., xxvi. (1905) pp. 347–51.
§ Op. cit., xxv. (1904) pp. 609–17.
‖ Op. cit., xxvi. (1905) pp. 298–317.

c. **General.**

Evolution of Tertiary Mammals.*—Charles Depéret maintains that the makers of pedigrees have been too hasty, e.g. in establishing lines of descent on the basis of the progressive functional adaptation of a particular part, such as a limb, or a bone, or a tooth. The evolution of European horses has been traced from *Palæotherium* and *Paloplotherium*, through *Anchitherium* and *Hipparion* to the modern horse. But there is good reason to believe that neither *Palæotherium* nor *Hipparion* nor *Anchitherium* were in the direct line of our horse's ancestry. The alleged filiation is fallacious, though it indicates the mode of the evolutionary process. The same is true with the history of bears as given by Gaudry and Boule.

Artificial filiations have been mistaken for real genealogies, and far too little time has been allowed. The evolution of a horse from a *Palæotherium* since the Oligocene, of a bear from *Amphicyon* since the middle Miocene, does not correspond to reality.

The author proposes to show that in each family and large genus there have been several parallel series; that pre-occupation with individual parts is sure to mislead; that in most cases there is a progressive augmentation in size, leading on to giants which end the series; that the greater number of phyletic branches terminate brusquely; that convergence or fusion of branches is very exceptional. These and other principles are to be illustrated first of all by a study of the Anthracotheridæ.

Variation in Tiger's Skull.†—Dr. Hilzheimer has made a number of measurements upon the skulls of Indian and Chinese tigers, and finds grounds for believing that there exists an osteological foundation for the colour varieties which are recognised, and advocates the study of such correlated variations. He finds, further, that numerous very small and so-called "unimportant" variations, such as are held necessary on the Darwinian Theory, are actually present.

Ossification of Pterygoid in Man.‡—E. Fawcett finds that the internal pterygoid plate is the first part of the sphenoid to become ossified. There is no evidence that it appears in cartilage. The hamular process undergoes chondrification before ossification, the cartilage resembles that which at the same time appears in the condyle, neck and base, of the coronoid process of the lower jaw. The external pterygoid plate is ossified in membrane as can be seen during the early part of the third month; it is not a downward continuation of the cartilaginous great wing.

Guide to Fossil Mammals and Birds in the British Museum.§—We have received the eighth edition of the useful guide to the fossil mammals and birds in the department of geology and palæontology in the British Museum (Natural History). Since the last edition was

* Comptes Rendus, cxl. (1905) pp. 1517–21.
† Zool. Anzeig, xxviii. (1905) pp. 594–9.
‡ Anat. Anzeig., xxvi. (1905) pp 280–6.
§ London (1904) 100 pp., 6 pls. and 88 figs.

published in 1896, the additions to the collection have been so numerous, and knowledge has advanced so much, that the book has been entirely re-written by Dr. Arthur Smith Woodward, the Keeper of Geology. It is an interesting and finely illustrated guide, useful even to those who cannot follow it from case to case.

Brain of the Chrysochloris.*—W. Leche describes the unique appearance of this brain, and compares it with that of other Insectivora. Looked at from above the brain shows nothing of corpora quadrigemina, cerebellum, or medulla oblongata; all are hidden by the cerebral hemispheres, the longitudinal axis of which is almost at right angles to that of the other parts. This is associated with the peculiar position of the foramen magnum and the peculiar direction of the axis of the basis cranii. Of peculiar interest, as illustrating convergence, is the resemblance between the brain of *Chrysochloris* and that of *Notoryctes*.

Comparative Osteology of the Accipitres.†—P. Suschkin contributes a large memoir on this subject. He discusses the classification of Accipitres in general and the characteristic modifications of the skeletal and other systems in the chief subdivisions. His chief attention has been given to the Falconidæ, in which he recognises four subfamilies:—Falconinæ, Poliohieracinæ, Polyborinæ, and (the most primitive forms) Herpetotherinæ.

Genera of Frogs.‡—J. Roux points out that in twenty-three years the number of genera in the family Ranidæ has been doubled. It now amounts to thirty-six. He gathers together the diagnoses of recent additions to the list with bibliographic references, and gives a diagnostic table of all the known genera up to the end of 1904. Following Boulenger's advice, he divides the family into two sections, according to the presence or absence of an intercalary bone between the two last phalanges, a point to which Peters first directed attention. Another useful basis of classification is found in the state of the sternum and the omosternum; both may be cartilaginous, or both may be ossified, or only the omosternum may be ossified.

Arrhenoid Changes in a Fish.§—E. Philippi reports an observation on *Glaridichthys caudimaculatus*, one of the Cyprinodonts, in which a female fish donned external masculine characters.

Ichthyological Notes.‖—L. Dantan publishes a number of details regarding the eggs and larval stages of *Clupea pilchardus*, *C. harengus*, *Ammodytes tobianus*, *A. lanceolatus*, *Rhombus maximus*, and *Belone vulgaris*, which will be of service in the difficult work of identification of fish-eggs and larvæ.

Action of Radium on Torpedo.¶—M. Mendelssohn finds that the application of radium to the electric organ either directly or through

* Anat. Anzeig., xxvi. (1905) pp. 577–89 (13 figs.).
† Nuov. Mem. Soc. Imp. Nat. Moscou, xvi. (1905) pp. 1–247 (4 pls.).
‡ Zool. Anzeig., xxviii. (1905) pp. 778–85.
§ SB. Ges. Natur. Freunde Berlin (1904), pp. 196–7.
‖ Arch. Zool. Exp. (Notes et Revue), No. 4, ser. 4, iii. (1905) pp. lxi.–lxxvii.
¶ Comptes Rendus, cxl. (1905) pp. 463–6.

the skin, did not immediately affect the ordinary discharges. After an hour the intensity of discharge was slightly modified, and by the end of five or six hours it was reduced by one half. There was never complete suppression even up to the end of eight days, and on being returned to the water recovery took place.

Geographical Variation in Pleuronectids.*—M. A. Cligny has made some observations on the dorsal and anal fin rays, and finds that the variations which exist do not depend on either age or sex, but that there is a progressive multiplication of rays; the forms with fewest occur furthest north, and these are more primitive.

Comparative Description of Lepadogaster bimaculatus Pennant and microcephalus Brook.†—F. Guitel has given a very exhaustive description of these two species, comparing the two sexes in each, and devoting a chapter to sexual differences. These two species which formerly were confounded, are easily separated in the male sex; the females are very similar, and in the young state are like the male of *microcephalus*. In *L. bimaculatus* the interesting discovery has been made that forms inhabiting the laminarian zone have in their kidney no *tubuli contorti*, while those dredged from deeper water possessed those tubules in varying degrees.

Reproductive Organs of Amphioxus.‡—B. Zarnik gives an account of the development of the gonad in both sexes, a statement of its structural relations, and also some histological details. He describes an excretory function which he finds is possessed by both ovary and testis, and in discussing their morphological significance claims *Amphioxus* as a very valuable connecting link between segmental invertebrates and vertebrates. He claims that the gonads arise from the mesoderm which in Selachii produce the primitive kidney; they are themselves excretory; their blood supply may be homologised with that of the Selachian primitive kidney; and there are other points all of which support the view that the gonads of *Amphioxus* are homologous with this organ.

Phylogeny of Post-caval Vein.§—W. Woodland describes a specimen of *Rana temporaria* in which the post-caval vein was absent, and replaced by a persistent right posterior cardinal. This abnormality has led him to seek a phylogenetic explanation of the origin of the post-caval vein. He finds it is related to the development of limbs which are locomotor (Tetrapoda) rather than balancing. So long as the trunk and the tail constitute one continuous locomotor body, so long is there little chance of the two posterior cardinals approaching the median line and completely fusing at a point midway in the length of the trunk, since this point is necessarily anterior as regards the body as a whole, and anteriorly flexion is of small degree. With locomotor limbs flexion of the trunk becomes accentuated, and acquires a new distribution. The primitive posterior cardinals are subject to a new distribution of forces, and,

* Comptes Rendus, cxl. (1905) pp. 526–9.
† Arch. Zool. Exp., ser. 4, ii. (1904) pp. 357–495 (1 pl.).
‡ Zool. Jahrb., xxi. (1904) pp. 253–338 (5 pls.).
§ Zool. Anzeig., xxviii. (1905) pp. 737–47.

tending to converge in the region of greatest flexion, in consequence are replaced midway in the length of the trunk by a median vein, the post-caval.

Causes of Senility.*—C. Henry and L. Bastien state that in man at senility there is a dehydration and consequent mineralisation. The mechanism of dehydration is to be found in the diminution of energy of the hydrolytic ferments, which fix water chemically on the nutriment and render it assimilable. On the diminution in intensity of these chemical actions, a part of the water held in the tissues now only by capillary action, tends to evaporate, and hence the dehydration. Loss in weight is further a direct result of the growing inactivity of these ferments. The problem of senility thus assumes a new phase; its solution becomes practicable by the co-operation of chemists and biologists.

Fresh-water Biological Stations.†—D. J. Scourfield gives a short account of what has been done in the United States and on the Continent in the way of instituting Fresh-water Biological Stations. So far the Sutton Broad Laboratory is the only fresh-water station that has been established in this country, but it is only fair to call attention to the good work which has been carried out in Scotland since 1892 by the Lake Survey under Sir John Murray. Mr. Scourfield makes a well justified plea for development in this direction, and just indicates what an ideal fresh-water biological station should aim at.

Tunicata.

Tunicate Blood System.‡—M. Fernandez has studied the microscopic anatomy and histological relations of the vascular system in Tunicates, and discusses the phylogeny of vascular systems in general. In *Salpa* the vessels are bounded by a thick membrane of connective tissue in which cells occur. In *Ascidia* muscle-fibres in addition occur around the larger vessels; these fibres originally belonged to the mesenchymatous body musculature, and are not homologous with the heart muscle. The blood cells in both *Ascidia* and *Salpa* are very variable in shape, and numerous types may be recognised, all of which arise by growth, or storing of nutrient material, or vacuolisation from small amœbocytes.

Pelagic Tunicates of the San Diego Region.§—W. E. Ritter reports on these, excepting the Larvacea. He describes *Cyclosalpa bakeri* sp. n., *C. affinis*, six species of *Salpa*, three of *Doliolum* (including the hitherto undescribed trophozooid of *D. tritonis*), and *Pyrosoma giganteum*.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Notes on Anatomy of Cephalopoda.‖—C. Chun describes a hitherto overlooked ciliated canal which opens into the end divisions of the

* Comptes Rendus, cxxxix. (1904) pp. 811-14.
† Journ. Quekett Micr. Club, 1905, pp. 129-36.
‡ Jenaische Zeitschr., xxxix. (1904) pp. 323-422 (4 pls.).
§ Univ. California Publications (Zoology) ii. No. 3 (1905) pp. 51-112 (2 pls.).
‖ Zool. Anzeig., xxviii. (1905) pp. 644-54.

vesicula seminalis where the latter bends round to the prostate gland. It was first observed in *Pterygioteuthis*, but is present in *Abraliopsis* and in *Illex*. It is of considerable length, and can be followed almost to the tip of the prostate (in *Abraliopsis* it projects beyond it); it ends in a ciliated funnel, which is 2 mm. long. The direction of the stream caused by the cilia could not be made out, and its function is doubtful. The author further discusses the morphology of the "genital pocket" which surrounds the sexual glands. It has no genetic connection with the body cavity, and is lined with ectoderm.

γ. Gastropoda.

Maturation in Enteroxenos östergreni.*—Kristine Bonnevie has made a detailed study of the maturation divisions in this remarkable Gastropod parasite of Holothurians. The general conclusions are the following. The apposition of each two homologous chromosomes in pairs in the synapsis stage is not transitory, but persists through both maturation divisions, and leads ultimately to complete fusion of the two conjugating chromosomes. Both maturation divisions are equation divisions, the process being complicated by the relatively large size of the spindles and by the doubling of the chromosomes. By the two rapidly succeeding divisions the double chromosomes are reduced to the normal size, while the reduction in number occurs in the synapsis.

Nervous System and Subradular Organ in Solenogastres.†—Harold Heath has studied these in a species of *Proneomenia* and a species of *Rhopalomenia*. On the ventral pharyngeal wall of the former the well-developed polystichous radula is placed, and immediately beneath its anterior border are two patches of high columnar cells, each group being capable of retraction within a sheath, or of being everted and fully exposed. Both are innervated from ganglia not hitherto described, and the author seeks to show that they are probably to be considered as the homologue of the sub-radular organ of the Chitons and some of the Prosobranchs. The nervous system is described in detail.

Tidal Periodicity in Littorina rudis.‡—G. Bohn finds that *Littorina rudis*, which lives in a zone upon the shore reached by the sea only once a fortnight, affords a clear case of periodicity. It alternates between a period of slowed-down life, the result of anhydrobiosis, and active life. This vital rhythm persists for months in aquaria, where the conditions are quite different from its natural haunt. During high tides the least shock provokes movement, and the animal is both geotropic and phototropic, while at low tide the opposite is the case.

Anatomy and Phylogeny of Haliotis.§—H. J. Fleure describes some details of the minute structure of certain organs, discussing blood-vessels, stomach, left kidney, the branch of the pleuro-visceral loop, and the otocysts. Regarding these and other structures, various new points have been brought out. The commissure between the anterior pedal

* Anat. Anzeig., xxvi. (1905) pp. 497-517 (33 figs.).
† Zool. Jahrb., xx. (1904) pp. 399-408 (1 pl.).
‡ Comptes Rendus, cxxxix. (1904) pp. 610-11.
§ Jenaische Zeitschr., xxxix. (1904) pp. 245-322 (6 pls.).

nerves and the ventro-lateral skeleton of the tongue apparatus are likewise described for the first time. Regarding the phylogeny, it is stated that the Trochidæ and Turbinidæ are doubtless nearly related to *Haliotis*, which shows a similar, though not so marked asymmetry and a like specialisation of the nervous system. Regarding the radula and nervous system, *Pleurotomaria* is probably more primitive than *Haliotis*, but with reference to the heart and branchial cavity the opposite is the case. They are probably nearly related, and have very early arisen independently from the same branch as the Prosobranchs, but not so early as the Docoglossids and Fissurellids. The relations of the nervous system and of the left kidney, suggest that the Monotocardia have not arisen from the Trochidæ and Haliotidæ.

Nematoblasts of Eolids.*—P. Abric gives some notes on the phases in the stinging cells of Eolids. The nematocysts are grouped upon the surface of the nematoblasts, and to these he gives the name of "agglutinating cells." Later, they pass within the agglutinating cells, whose reactions change; they are now stainable with eosin, and are functional. There appears to be a periodicity in the agglutinating cells, for in *Acanthopsole* they were found inactive at the end of spring.

δ. Lamellibranchiata.

Gill of Pearl Oyster.†—W. A. Herdman calls attention to some points of interest in the structure of the gill of the Ceylon pearl-oyster. The first of these is the presence of extensive ciliated junctions (1) in the median line between the inner gills of the two sides, and (2) laterally between each outer gill and the mantle-lobe. The second is the presence of somewhat extensive organic connections between the adjacent gill-filaments of a plica at the level of the ciliated discs. In this character of the interfilamentar junctions, as well as in that taken from the connections of the gills with neighbouring parts, this member of the Eleutherorhabda shows an approach to the Eulamellibranchiate condition.

Arthropoda.

α. Insecta.

Synopsis of Families of Palæarctic Lepidoptera.‡—K. von Hormuzaki furnishes a useful analytical synopsis of the families of Palæarctic Lepidoptera, for the most part in the form of diagnostic tables, with illustrations of venation.

Variation in Melitæa aurinia.§—V. P. Kitchin discusses the chief tendencies to variation in this butterfly, as noted from a series of 110 Irish specimens. There are three principal variations in general appearance, according as the chestnut, or the yellow, or the black colour predominates. Variations on the upper wing, on the under wing, and so on, are noted, as well as a few pathological aberrations.

* Comptes Rendus, cxxxix. (1904) pp. 611–13.
† Journ. Linn. Soc. (Zool.) xxix. (1905) pp. 226–9 (1 pl.).
‡ Analytische Uebersicht der paläarktischen Lepidopterenfamilien. 8vo, Berlin (1904) 68 pp., 45 figs. See Verh. Zool. Bot. Ges. Wien, lv. (1905) p. 128.
§ Trans. Hertfordshire Nat. Hist. Soc., xii. (1905) pp. 165–7 (1 pl.).

Structure and Development of the Compound Eye of the Honey Bee.*—E. F. Phillips has made a careful study of this, and comes to the following conclusions. The primitive arrangement of the ommatidia is tetragonal. The hairs over the lens are secreted by bi-nucleated hair-cells, with intracellular ducts, which lie between the ommatidia. The ommatidium arises as a group of cells with superimposed nuclei, which later become arranged as a spindle surrounded by smaller cells. This spindle is the retinula, and the cone cells and pigment cells assume a distal position by a morphological invagination.

The retinula is the centre of the ommatidium, and the cone cells, corneal pigment cells and outer pigment cells, follow in the order named. The ommatidium is composed of eight or nine retinular cells around the rhabdome, four cone cells, two corneal pigment cells, and about twelve outer pigment cells.

The rhabdome and cone are intracellular secretions, while the lens is an extracellular secretion of the pigment cells. The corneal pigment cells are homologous with the corneal hypodermal cells of crustacean and apterygote ommatidia. The innervation of the ommatidium is by a differentiation of part of the retinular cells into nerve fibrils, and these extend to the retinular ganglia. The lens is secreted by the corneal pigment cells, which early in the pupa stage are distal to the cone, and possibly also by the outer pigment cells. Pigment is formed inside all the cells of the ommatidium, except the cone cells, by a cytoplasmic differentiation.

The ommatidium arises from a strictly one-layered epidermis, which passes directly from the larva to the pupa without the loss of any cells or additions from other tissues.

Foot of House-Fly.†—A. A. C. Eliot Merlin describes what is in all probability the orifice from which exudes the viscous fluid which may be seen adhering to, and often entirely enveloping, the sickle filament. With a magnification of 3200 diameters he discovered an excrescence which protrudes from the side of the sickle just midway between the point and the haft.

New Œstrid Larva from Hippopotamus.‡—K. Grünberg describes *Rhinœstrus hippopotami* from the cranial cavity of the hippopotamus. It differs chiefly in its spines from *Rh. purpureus* from the nasal chamber of horse and zebra.

Metamorphosis of Lebia scapularis.§—F. Silvestri describes the metamorphosis and habits of this small carabid beetle, which attacks the eggs, larvæ, and nymphs of *Galerucella luteola*. It is remarkable in exhibiting a hypermetamorphosis—having two well defined larval forms —and it is unique in constructing a silken cocoon which is secreted by the malpighian tubes.

* Proc. Acad. Nat. Sci. Philadelphia, 1905, pp. 123–57 (3 pls.).
† Journ. Quekett Micr. Club, 1905, pp. 167–8 (6 figs.).
‡ SB. Ges. Natur. Freunde, Berlin, 1904, pp. 35–9 (2 figs.).
§ Redia, ii. (1904) pp. 69–84 (5 pls.).

Function of the Follicular Epithelium in Melolontha vulgaris.* —Th. Mollison finds that the terminal chamber of the ovarian tube contains only oocytes and young epithelial cells, and that the latter alone have to do with the nutrition of the growing eggs, sometimes using the debris of superfluous oocytes. This nutritive activity of the epithelial cells finds structural expression in pseudopodium-like processes which penetrate into the egg, and in the formation of nutritive strands, or it may be a nutritive zone, around the egg. The egg also takes an active part in forming its cytoplasmic reserves.

Monograph of Australian Cicadidæ.†—F. W. Goding and W. W. Froggatt have done a useful piece of work in monographing the Cicadidæ of Australia. The paper contains descriptions of 119 species included in 21 genera. The new genus *Pauropsalta* is separated off from *Melampsalta*. Attention is directed to the very wide distribution of some of the forms, e.g. *Tibicen willsi* and *Melampsalta annulata*. The appearance of members of the genera *Gœana* and *Huechys* is interesting as showing the relation of Australian forms with those of the Indo-Malayan region.

Salivary Glands in Nepa cinerea.‡—L. Bordas describes (1) the posterior salivary glands, which consist of numerous acini opening into a central canal, and resemble elongated bunches of grapes, and (2) the maxillary or cephalothoracic glands, which have no connection with the alimentary tract, but are associated with the posterior maxillæ.

Glands of Hemiptera.§—L. Bordas gives an account of the salivary, cephalic and metathoracic glands of various Hemiptera. One or two notes on the last of these may be here given. They are paired organs consisting of ramified tubes situated at the posterior extremity of the sternal arch of the metathorax of Gerridæ. The central canal possesses a thick chitinous coat supporting the epithelial layer. The proximal extremity of each glandular tube ends in a median ovoid mass, acting as a reservoir. This last opens to the exterior by a transverse slit on the median line of the metathorax. The interior lining of the reservoir has long and fine denticulations with silky horns.

Thorax of Gryllus domesticus.‖ — F. Voss continues and concludes his investigations on the thorax of *Gryllus domesticus* and of insects generally. Some of the more important conclusions arrived at may be briefly stated. Homologies in the skeleton extend to the wing and its joints; muscles of meso- and meta-thorax are completely homologous, those of the pro-thorax are so on a somewhat more general basis. The "micro-thorax" is the epimeral section of the segment of the second maxillæ; dorsal parts of the prothorax are included in the occipital ring. Both pairs of wings are of equal morphological value; they are purely tergal outgrowths, and are not homologous with tracheal

* Zeitschr. wiss. Zool., lxxvii. (1904) pp. 529–45.
† Proc. Linn. Soc., xxix. (1904) pp. 561–669 (2 pls.).
‡ Anat. Anzeig., xxvi. (1905) pp. 403-6 (3 figs.).
§ Comptes Rendus, cxl. (1905) pp. 595-7.
‖ Zeitschr. wiss. Zool., lxxviii. (1905) pp. 620–759 (1 pl.).

gills. *Gryllus* has, although a degenerate form, a primitive organisation which serves as a link connecting most insect orders.

Species of Pœciloptera.*—A. Jacobi discusses this genus, and in particular the series of forms which may be ranked under *P. phalænoides*, with the aim of showing that the facts support the theory of the origin of species by spatial isolation. He indicates that this view is gradually supplanting the theory of the origin of species by natural selection.

δ. Arachnida.

Ticks as Transmitters of Bovine Diseases.†—A. Laveran and M. Vallée report that they received from M. Theiler, a veterinarian at Pretoria, some larvæ of the tick *Rhipicephalus decoloratus*, which he had found to be the transmitter of spirillosis in cattle. The mother-tick had been taken from an infected beast. Messrs. Laveran and Vallée have verified the experiment; the ticks were put on healthy beasts, and spirillosis soon resulted. Piroplasmosis also ensued.

Fertilisation in Mites.‡—E. Trouessart describes the mode of insemination in Sarcoptidæ and Tyroglyphidæ. The sperm is stored in a special receptaculum seminis; the coitus occurs through a special opening in the female, remote from the genital opening, which serves only for the liberation of eggs or embryos. Usually the male unites not with an adult female but with a sexually mature nymph. The external sperm-sac opening in the nubile nymphs of Sarcoptidæ and Tyroglyphidæ appears after and in consequence of copulation. The male must pierce the opening with his pointed chitinous penis.

Arachnological Notes.§—Vl. Kulczynski describes some new species, e.g. *Rhomphæa longa*, *Lephthyphantes kotulai*, *Saitis græca*, and makes a note on the stridulatory organs in both sexes of many Theridiidæ.

New Breathing Organ in Mites.‖—K. Thon describes in the genus *Holothyrus* Gerv. a new respiratory structure. Behind the stigma slits there is a roomy vestibulum, which through a narrow passage leads to a larger atrium. Both chambers are covered with epidermis, and from the atrium there arise a number of tracheal branches. The atrium appears to be connected by muscle strands to the dorsal wall of the body. There are other peculiarites reserved for future consideration, in view of which the author removes the genus from the order Mesostigmata, establishing a new order, Holothyrida, for its reception.

ε. Crustacea.

Notes on Crustacea.¶—H. Coutière gives some notes on certain oceanic Macrura obtained on a cruise of the 'Princess Alice' by

* SB. Ges. Natur. Freunde, Berlin, 1904 pp. 1–14 (2 figs.).
† Comptes Rendus, cxl. (1905) pp. 1515–17.
‡ Comptes Rendus Soc. Biol., lvi. (1904) pp. 367–8. See also Zool. Zentralbl., xii. (1905) pp. 32–3.
§ Bull. Internat. Acad. Sci. Cracovie, (1904) pp. 533–68 (1 pl.).
‖ Zool. Anzeig., xxviii. (1905) pp. 585–94.
¶ Comptes Rendus, cxl. (1905) pp. 1113–15.

means of a wide-mouthed vertical net. This net acts so as to capture animals living at different levels of the vertical column through which it works. The results were remarkable as regards the new species obtained, and notes regarding some of these are given, e.g. *Hymenodora parva* sp. n. from a depth of 3000 metres, and *Oplophorus Grimaldii* sp. n., a magnificent crustacean, from 2000 metres.

Structure of Heart in Malacostraca.*—W. Gadzikiewicz has examined the heart in a large number of types, and finds it possesses an inner muscularis and an outer adventitia. An endocardium is not present. As an illustration, some details concerning *Nebalia*, one of the forms examined, may be given. Here the inner muscularis is differentiated into muscle fibres lying close to one another, each having an independent sheath. The fibrillæ lie peripherally in the protoplasm of the fibres. The blood corpuscles lie on the inner layer, blend with it, forming irregular and often marked thickenings of the protoplasmic substance (sarcolemma) of the muscle fibres. The outer envelope (adventitia) consists in *Nebalia* of very large cells with gigantic nuclei; in *Gammarus* and *Squilla* it forms a cellular membrane.

Structure and Development of Pœcilasma aurantium.†—Kurt Hoffendahl has made a study of this barnacle found on the crab *Geryon affinis* by the German Deep Sea Expedition. The following are some of his results. The basal joints of the attaching antennæ are lost with the bivalve shell, and do not contribute to the peduncle. The bivalve shell is in close connection with the mantle by means of a strong insinking of chitinous substance. All the muscles, except that closing the shell, are striped. The pancreas is a modified portion of the stomach; there are no other stomachic glands, but there are noteworthy diverticula from the œsophagus and from the stomach. The chitinous tube often found in the stomach of Lepadidæ is the isolated cuticle. The mantle-gland and the cement-gland are closely connected; their secretions pass out by a common duct; the mantle-gland is a larval cement-gland. The kidney is a modified portion of the body-cavity, and retains its connection with it. Nussbaum's "undefinierbare organ" is a salivary gland. Darwin's "auditory organ" at the base of the first cirrus is in direct connection through the oviduct, with the ovary, which lies in the mantle. The peculiar homogeneous mass in the widened terminal part of the oviduct is a hardened secretion. The absence of heart and blood-vessels is confirmed.

Indian Ocean Paguroids.‡—A. Alcock continues his study of the Indian Decapod Crustacea in the Indian Museum. The new instalment is an elaborate memoir on the Paguroidæ, or Paguridea, a group which includes four families, namely, Pylochelidæ, Paguridæ, Cœnobitidæ, and Lithodidæ. The author begins with an interesting chapter of general observations on the Paguridea and with a discussion of their distribution. Then follows the systematic account of the first three families named

* Jenaische Zeitschr., xxxix. (1904) pp. 203–34 (4 pls.).
† Zool. Jahrb., xx. (1904) pp. 363–98 (4 pls.).
‡ Catalogue of the Indian Decapod Crustaceans in the Collection of the Indian Museum, part ii. fasc. i. (Calcutta, 1905) 197 pp., 16 pls.

above, the deep-water Lithodidæ having been previously dealt with. At the end there is a table of the genera and species of recent Paguridea.

New Species of Cymonomus.*—A. Alcock describes *Cymonomus andamanicus* sp. n., a small, blind, deep-sea crab, belonging to the Oxystome family Dorippidæ. He also discusses the geographical distribution of the family, which raises some interesting inquiries; and has some remarks to make on the allied genus *Cymonomops*.

Life of Salt-Marsh Amphipod.†—Mabel E. Smallwood gives an interesting account of the behaviour of *Orchestia palustris* from the salt marsh of Cold Spring Harbor. Both their colour and their shape when quiet are highly protective. Adults were mating and carrying young during July and August. The male carries the passive female for hours or even days during the mating period, a habit found in many aquatic forms and retained by this terrestrial one.

They swim and slide around on one side, they also hop, not as often nor as far as *Talorchestia longicornis*, but with more judgment, and they run well and rapidly.

They orient readily in response to gravity; they are photokinetic, and usually negatively phototactic; they are very sensitive to contact. They can endure great variations in salinity and humidity. They eat any waste organic matter. They do not burrow, but rest in accidental crevices, depressions, or frail, dome-covered excavations. Their chief animal enemies are probably little fishes, birds, spiders, and beetles.

We have here a fine example of a simple ethological memoir.

Fresh-water Plankton Crustacea.‡—V. Brehm and E. Zederbauer report on the Plankton of Alpine lakes, and, *inter alia*, direct attention to the differences in the size of *Bosmina coregoni* in September and in December, and to the marked age-variations and seasonal variations in the head-region of (*Hyalo-*) *Daphnia cucullata* Sars.

So-called "Olfactory Setæ" of Cladocera.§—D. J. Scourfield discusses the varied structure, size, and distribution of the chemically-sensitive setæ in different types of Cladocera, and notes especially their frequently greater development in the males. He regards them not merely as gustatory, but as organs of a more generalised chemical sense.

Fixation of Lernæenicus Sardinæ.‖—Marcel Baudouin gives a precise account of the manner in which this parasitic Copepod fixes itself on the dorsal surface of the sardine, near the middle lateral region of the dorsal fin. The actual fixing is effected by the cephalothorax, but after insertion the cephalothorax and the tail disappear in the muscle, leaving the swollen genital region, which has a red colour.

* Ann. Nat. Hist., xv. (1905), pp. 565–77 (1 pl.).
† Cold Spring Harbor Monographs, iii. (1905) 21 pp., 2 pls. and a map.
‡ Verh. Zool. Bot. Ges. Wien, lv. (1905) pp. 222–40 (7 figs.).
§ Plöner Forschungs., xii. (1905) pp. 340–53 (2 pls.).
‖ Comptes Rendus, cxl. (1905) pp. 326–7.

Annulata.

Maturation in Allolobophora fœtida.*—K. Foot and E. C. Strobell give a number of facts regarding the prophase and metaphase of the first maturation spindle of *Allolobophora*, only a few of which can be quoted. During the prophases there is a marked change in the structure of the cytoplasm, a decrease in the size of the egg, and an increase in the amount of the substance between the egg membrane and the outer membrane. The centrioles are first seen at opposite poles of the germinal vesicle, indicating that they arise independently. The nucleolus is intact at this stage; the centrioles do not arise from it. The functional value of the nucleolus is probably confined to the nucleus. There is some evidence to support the theory of the individuality of the chromosomes, and in general the authors' observations on the division of the chromosomes appear to confirm the work of previous workers on other forms.

Phagocytary Resorption in Seminal Vesicles of Lumbricus.†—L. Brasil points out that the presence of numerous amœbocytes in the seminal vesicles of *Lumbricus* is normal and constant. They exercise an intense phagocytary resorption upon the unutilised reproductive elements, and also upon their empty cytophores. They completely clean these elements after emissions. Their action upon the cysts of Gregarines is secondary, and these are not the direct cause of their presence.

Setal Pockets in Polychæts.‡—A. Schepotieff has studied these in *Nereis cultrifera*, *Protula intestinum*, *Nephthys scalopendroides*, and *Eunice viridis*, the palolo-worm. There is no great difference between the setal pockets in those Polychæts and the similar structures in Oligochæts. Typically, each seta is the product of a single formative cell, which lies at the base of an epithelial invagination—the setal pocket. The differences in the various forms, and as regards the various kinds of setæ, are described.

New Species of Sea-Mouse.§—J. Percy Moore describes *Aphrodite hastata* sp. n., from eastern Massachusetts, which differs in many and striking characters from *A. aculeata*, e.g. in the altogether different form of the large notopodial spines. It is really less closely related to *A. aculeata* than to other species of the genus, and probably finds its nearest ally in *A. japonica* Maren., which is widely distributed in the Northern Pacific. There is doubt, therefore, where the true *A. aculeata* really occurs on the American Atlantic coast, as has been generally assumed.

Regeneration in Protodrilus.‖—N. Lignau has studied the regeneration of the anterior and posterior regions of the gut, and the

* Amer. Journ. Anat., iv. (1905) pp. 199-243 (9 pls.).
† Comptes Rendus, cxl. (1905) pp. 597-9.
‡ Zeitschr. wiss. Zool., lxxvii. (1904) pp. 586-605 (3 pls. and 7 figs.).
§ Proc. Acad. Nat. Sci. Philadelphia, 1905, pp. 294-8 (4 figs.).
‖ Mem. Soc. Nat. Nouv-Russie, xxvii. (1905) pp. 1-40 (2 pls.).

regeneration of the head-ganglia in *Protodrilus flavocapitatus* Uly. The process is very rapid and the restoration is complete, except that the eyes were only regenerated in 3 out of 200 cases. In the restoration of the anterior end of the gut, there is a co-operation of ectodermal and endodermal cell-groups. The head-ganglia appear as a group of spherical cells on the ventral side below the mouth, and are gradually shunted upwards, separating off from the epidermis, and differentiating Punktsubstanz on the posterior inner side. In the regeneration of the tail end the tip is first formed, and new segments are interpolated from behind forwards between the tip and the old segments.

Artificial Parthenogenesis in Thalassema mellita.*—George Lefevre finds that the eggs of this worm can be induced to develop without fertilisation by immersion for a few minutes in very dilute solutions of nitric, hydrochloric, sulphuric, carbonic, acetic, and oxalic acids. In favourable experiments 50–60 p.c. of the eggs developed into active trochophores which were strikingly normal in appearance and structure.

An egg-membrane invariably forms shortly after removal from the acid solutions, and maturation, identical with the normal process, frequently occurs. In a number of cases polar bodies were not extruded, but sections showed that the maturation process had taken place internally. In some cases four nuclei are formed in the cytoplasm, which represent the egg-nucleus and the nuclei of three polar bodies. These four nuclei fuse to form a cleavage-nucleus.

The egg-centrosome disappears after the formation of the second polar body, and the cleavage centrosomes are formed *de novo*. It was frequently observed that the polar bodies continue to divide and form a morula-like cluster of minute cells. Cell-divisions take place mitotically, and in many cases the early cleavage is perfectly normal, although a great variety of abnormal cleavages also occur.

Sexual Forms in Fresh-water Nereids.†—Ch. Gravier discusses a new fresh-water Nereid (*Perinereis* Kinberg char. emend.) found by G. Seurat in a rain-water basin in one of the low islands (Tarauru-roa) of the archipelago of Gambier. Some specimens of this *Perinereis seurati* sp. n., have ova in various stages of development, and the body-wall is reduced to a delicate semi-transparent sac with little musculature. There is a very slight trace of parapodial modification, namely, very vascular foliaceous lobes, a mere hint of the epigamous transformation of marine relatives.

Crystals in Hirudo and Pontobdella.‡—W. Kolmer found in preparations of ganglion cells of these leeches which had been fixed in 5 p.c. formalin, numerous crystals of a clear ruby colour, strongly refractive and in most cases apparently belonging to the rhombic system. No hint of them was found in any other tissue, and it is not known whether they are present during life.

* Science, xxi. (1905) p. 379. † Comptes Rendus, cxl. (1905) pp. 1561-2.
‡ Anat. Anzeig., xxv. (1904) pp. 618–21.

Nematohelminthes.

New Genus of Terrestrial Nematode.*—L. A. Jägerskiöld describes a small free-living terrestrial Nematode from Kerguelen, *Bunonema richtersi* g. et sp. n. Along the ventral side of the body it bears two parallel rows of relatively large wart-like bodies. The mouth is provided with bristles, is small, and may be absent. There are longitudinal ridges along the sides, and the cuticle between the warts is smooth or coarsely granular.

Notes on Nematodes.†—A. E. Shipley reports 15 Nematodes, mostly species of *Ascaris*, from fishes, seals, dolphins, etc., all from the museum of University College, Dundee.

Platyhelminthes.

Bactericidal Action of Cestodes.‡—L. Jammes and H. Mandoul note that the extract of tapeworms has a bactericidal power, varying in different species, and in relation to different microbes. The parasites resemble the wall of the intestine in their absorptive capacity and in their bactericidal power. This is an adaptation to intra-intestinal parasitism. Sometimes the parasite may aid its host in the bactericidal function. In Nematodes, where there is a continuous cuticle, there is no bactericidal power.

Notes on Cestodes.§—A. E. Shipley has notes on the curious twisted tapeworm *Anthobothrium tortum* v. Lins, from the stomach of *Phoca barbata*. The edges of the animal are thickened, and the whole is twisted or coiled round its longitudinal axis. The head bears firm cushions and in the centre a maze of convoluted ridges. Two good figures are given. Nine other forms are noted, all from the museum of University College, Dundee.

New Bird Tapeworm.‖—M. Szymanski gives a description of *Hymenolepis* (*Drepanidotænia*) *podicipina* sp. n., from the crested grebe. In the same host he found young forms of *Tænia furcifera* Krabbe without proglottides.

Arctic Cestodes.¶—F. Zschokke finds that in the far North the Cestode fauna includes typically polar forms as well as cosmopolitan types. The genera *Dibothriocephalus* and *Tetrabothrius* are examples of the former, and to these may be added with some probability certain species of the genera *Diplogonoporus* and *Diplobothrium*. The wanderings of the hosts, viz. birds and fishes, introduce uncertainty in the cases of other Cestodes occurring in the far North, as well as in some of those quoted. In Mammals there occur *Moniezia expansa*, *Tænia serrata*, and *Tænia cœnurus*; in Birds, *Dilepis undulata*, *Fibriaria fasciolaris*, *Drepanidotænia filum*, *Anomotænia microrhynchus*, and many others; and

* Zool. Anzeig., xxviii. (1905) pp. 557–61.
† Proc. Cambridge Phil. Soc., xiii. (1905) pp. 95–102.
‡ Comptes Rendus, cxl. (1905) pp. 271–3.
§ Proc. Cambridge Phil. Soc., xiii. (1905) pp. 95–102 (2 figs.).
‖ Bull. Internat. Akad. Sci. Cracovie, 1904, pp. 733–5 (1 pl.).
¶ Fauna Arctica, Bd. iii. (1903) pp. 1–32 (2 pls.).

in Fishes, *Schistocephalus nodosus*, *Triænophorus nodulosus*, *Abothrium rugosum*, etc. There is a remarkable parallelism between this and the Antarctic fauna, and a bipolar distribution of the Cestodes is recognisable.

New Helminths.*—O. v. Linstow describes, mostly from mammals, several new species of Helminths. An interesting form is *Tetrarhynchus fluviatile* sp. n., from a thick walled cyst in the connective tissue of *Malapterurus electricus* from the Nile. The scolex measured 0·35 mm. long and posteriorly 0·088 mm. broad; there are four long oval suckers and four proboscides, which appear to be without bulbs. The genus in its sexual phase is marine, occurring in sharks and rays, and the *Malapterurus* must occasionally leave the Nile for the sea and there be infected.

Anatomy, Development and Habits of Geonemertes agricola.†—W. R. Coe gives a general account of the anatomy and fuller particulars of the development and habits of this terrestrial Nemertean. The species occurs at several places on the Bermuda Islands, but is known only along the shores of mangrove swamps and on the adjacent hillsides. The worms do not burrow, but lie beneath stones; they are very hardy, and survived immersion in salt water for several weeks without food or change of water. They can live in comparatively dry earth without injury; they cannot live in fresh-water alone, although they survive its addition to the soil or salt water in which they may be placed. This species has probably arisen directly from a marine ancestor.

North American Nemerteans.‡—W. R. Coe publishes an account of the Nemerteans of the West and North-West Coast of North America. The data are obtained from a study of a large number of collections from many localities, and include an anatomical and histological survey with special reference to the Pacific coast species, notes on development and geographical distribution. A systematic account of the genera and species with descriptions of new forms, together with keys to the groups and species, is also included.

Incertæ Sedis.

Position of Rhabdopleura.§—A. Schepotieff directs particular attention to the three segments of this interesting type—(1) the head-shield, (2) the neck portion from which the lophophore arises dorsally, and (3) the oval trunk portion, to the endodermic notochord and to the branchial grooves. He gives an account of the whole structure of the animal based on his own investigations, and also describes the stages in the development of the buds. He believes that *Rhabdopleura* and *Cephalodiscus* are nearly related, that Brachiopods and Chætognatha are also related to both, and that *Rhabdopleura* has more remote affinities with *Phoronis* and the Bryozoa on the one hand, and through the Enteropneusta with Echinoderms and Chordates on the other. In short, *Rhabdopleura* and *Cephalodiscus* are primitive "Trimetamera."

* Centralbl. Bakt. Parasitenk., xxxvii. (1904) pp. 678–83.
† Proc. Boston Soc. Nat. Hist., xxxi. (1904) pp. 531–70 (3 pls.).
‡ Bull. Mus. Compar. Zool. Harvard, xlvii. (1905) pp. 1–320 (25 pls.).
§ Zool. Anzeig., xxviii. (1905) pp. 795–806 (7 figs.).

Notes on Young Enteropneusta.*—W. E. Ritter and B. M. Davis give an account of a number of interesting features in the development and habits of *Tornaria ritteri* and others. Diminution of size marks the metamorphic period during which both retrogressive and progressive changes are taking place. It appears that the difference in size and form assumed by the larva at different times in its career is more a question of the distribution of a nearly constant quantity of body substance than of the addition and distribution of new substance. Their researches have strengthened the suggestion of a general functional similarity between the œsophageal ciliated band previously described by Ritter and the prochordate endostyle, although the question of true homology remains as doubtful as ever. The vital activities of this animal are at a very low level; food-taking seems to be wholly wanting for a large part of the larval period; respiration and excretion are on the simple protoplasmic level; responses to stimuli are detected only with difficulty; body movements are effected exclusively by cilia. The eggs are deposited on the sea bottom, while the larvæ are pelagic. The larvæ rise by a reduction of their specific gravity and by the action of their cilia. They swim upward in a spiral manner. *Tornaria* appear to react but slightly if at all to light of normal intensity. Particulars of a new species, *Tornaria hubbardi*, are given, and some notes on the direct development of *Dolichoglossus pusillus* Ritter.

Germ-Cells in Pedicellina americana.†—L. I. Dublin has studied the history of the chromatin of the germ-cells, and finds that oogenesis and spermatogenesis are in general identical processes. The normal number of chromosomes is probably twenty-two, and full details of the maturation divisions are given. The eggs are fertilised internally, and the pronuclei do not unite intimately; the chromosomes are very early re-formed and give rise to twenty-two V's of the first somatic mitosis; they split longitudinally and preserve this form up to the last spermatogonial and very probably oogonial generation, where they are converted into dumb-bell shaped rods. The egg nucleolus appears early during the oocytic growth-period, and increases in size at the expense of the cleavage products of the chromatin; later it becomes vacuolated, stains throughout as a plastin body, and with the approach of the first maturation division disintegrates, the remains being cast out as a metanucleolus.

Echinoderma.

Variability and Autotomy of Phataria.‡—Sarah P. Monks discusses *Phataria* (*Linckia*) *unifascialis* Gray, var. *bifascialis*, a starfish remarkable for the variability in the size and number of its rays. Regularity is the exception. In over 400 specimens, not more than four were symmetrical, and no two were alike.

The breaking is automatic, and is effected by pulling apart or fracture without strain; there is co-ordination of parts in producing the separation; the tissues relax at the plane of rupture; this plane may be

* Univ. California Publications, i. (1904) pp. 171–210 (3 pls.).
† Annals N.Y. Acad. Sci., xvi. (1905) pp. 1–64.
‡ Proc. Acad. Sci. Philadelphia, 1904, pp. 596–600 (1 pl.).

near the disc, or at a variable distance along the ray; the pyloric cæca are always pulled out and much stretched; the break of the cæcum occurs at the tube connecting the stomach and glandular portion; the pyloric cæcum is generally taken back into the arm; the severed ray may live more than a week without signs of regeneration; rays cut at various distances from the disc make discs, mouths and new rays in about six months.

Sea-urchins of German Deep-Sea Expedition.* — L. Döderlein describes fifteen forms, all of which, excepting one, are new species, and amongst which are representatives of five new genera.

The Origin of the Water-Vascular System of Echinoderms.† — E. Meyer seeks to throw some light on this question. He homologises the two cœlome divisions in the Prosopygia with the two pairs of cœlome vesicles of the echinoderm Dipleurula larva. These cavities are not to be regarded as cœlome metameres. They are comparable in origin, rather to the anterior and posterior thoracic cavity of Terebellids, through the disappearance of regular intersegmental septa, and equivalent to the sum of several segment cavities. The hydrocœlic vesicles of echinoderm larvæ, on the contrary, have, since they correspond to the diaphragm sacs of Terebellids, merely the significance of a muscular hollowing out of a dissepiment which has remained between the anterior and posterior cœlome. The ontogeny of echinoderms bears this out, since both hydrocœls, rudimentary and definitive, arise typically as eversions of the hinder epithelial wall of the anterior cœlome. The evolution of the complex hydraulic apparatus of the adult echinoderm from such open diaphragm sacs, is partly to be understood by reference to certain Annelids, for example, *Saccocirrus*, in which in the head and tentacles there exists a canal- and ampullæ-system comparable to the echinoderm water-vascular system.

South African Echinoderms.‡—F. Jeffrey Bell reports on Asteroidea and Ophiuroidea found off the coast of South Africa. The Cape Starfishes show an alliance with those of the North Atlantic, but there are also indications of the presence of species best known as yet from the Indian Ocean; this is, indeed, only to be expected when we examine the trend of the currents round the southern peninsula of the Old World. A new *Palmipes* (*P. novemradiatus*) is described, the only one known with more than five rays, and the total list mounts up to a score. The author notes the variability of *Astropecten pontoporæus*, and the growth-stages of the previously rare and little known *Pentagonaster tuberculatus* of Gray.

The Ophiuroids number eleven, including *Ophiozona capensis* sp. n., and *Ophiura trimeni* sp. n., and a good series of the hitherto rare *Ophiothamnus remotus*, which was dredged by the 'Challenger' in the neighbourhood of the Cape. Professor Bell notes that the study of Ophiuroids has suffered much from the description of isolated "species" based on one or a few specimens. This is notably the case with *Ophio-*

* Zool. Anzeig., xxviii. (1905) pp. 621–4.
† Zool. Jahrb., xxi. (1904) pp. 339–78.
‡ Marine Investigations in South Africa, iii. (1905) pp. 241–53, 255–60 (1 pl.).

thrix, of which a revision, based on a long series, ought to be made before ever another species of it is described.

Antarctic Holothuroids.*—Rémy Perrier reports on the Antarctic Holothuroids from Patagonia and New Zealand in the museums at Paris and Vienna. He describes 19 species from Patagonia, and 11 from New Zealand—e.g. *Synallactes moseleyi* (Théel) Rémy Perrier, *Stichopus* (*? Holothuria*) *patagonicus* Rémy Perrier, *Psolidium convergens* (Hérouard) Rémy Perrier, *Pseudopsolus macquariensis* (Dendy) Ludwig, *Caudina pulchella* sp. n., *Trochodota purpurea* (Lesson) Ludwig, and *Chiridota marenzelleri* Rémy Perrier.

Deep Sea Holothuroids of Indian Ocean.†—R. Kœhler and C. Vaney report on a large collection of 75 species of deep-sea Holothuroids, of which 59 are described as new.

Cœlentera.

List of Irish Cœlentera.‡—Jane Stephens has compiled a useful list of Cœlentera from the Irish marine area. It includes about 250 species, excluding many doubtful ones. The hydroids are mostly widely distributed species, some of them having been recorded for North America, India, Australia, and New Zealand. On the other hand, *Tubiclava lucerna*, *T. cornucopiæ*, and *Heterocordyle conybearei* have been recorded for two, or at the most, three localities; while *Perigonimus gelatinosus*, *P. inflatus*, and *Campanulina turrita* seem to have been found hitherto only off the Irish coast.

The overlapping of species characteristic of the northern and southern faunas on the south-west coast of Ireland is illustrated. Thus, among the Hydromedusæ, *Melicertidium octocostatum* and *Margelis pyramidata* are northern forms, while the Siphonophore *Muggiæa atlantica* is southern. The Trachomedusæ and Narcomedusæ are essentially Atlantic forms. Among the Sea-anemones *Epizoanthus incrustatus*, *Parazoanthus anguicomus*, and perhaps *Actinauge richardi*, may be regarded as northern species, while *Gephyra dohrnii* is distinctly southern.

Bougainvillia fruticosa Allm.—a Variety of B. ramosa, Van Ben.§—P. Hallez states that these are two varieties of the same species. *B. ramosa* is a calm-water form, and *B. fruticosa* a product of water in continuous agitation. He regards this instance as a further proof of the morphogenic action of water in motion, as has been quoted by Giard in the case of *Campanularia caliculata* Hincks.

Classification of Medusæ.‖—O. Maas has revised Haeckel's family of the Cannotidæ, and finds it a heterogeneous group. He rearranges the members thus:—Anthomedusæ (near the Tiaridæ), families, Bythotiaridæ, Williadæ. Leptomedusæ (near the Thaumantiadæ) families, Berenicidæ, Polyorchidæ.

* Ann. Sci. Nat. (Zool.) sér. 9, i. (1905) pp. 1-80 (10 figs.).
† An Account of the Deep-Sea Holthuroidea collected by R.I.M.S. 'Investigator,' (Calcutta, 1905) 123 pp., 15 pls.
‡ Proc. R. Irish Acad., xxv. Sect. B, No 3 (1905) pp. 25–92.
§ Comptes Rendus, cxl. (1905) pp. 457-9.
‖ SB. K. Akad. Wiss. München, 1904, pp. 421–45.

New Cavernularid from Ceylon.*—J. J. Simpson describes an interesting new type found by Professor W. A. Herdman in Ceylonese waters. He names it *Fusticularia herdmani* g. et sp. n., and gives the following diagnosis: a somewhat sponge-like Cavernularid, with a flattened ovoid stock separated by a constriction from a comparatively slender sterile trunk; with dimorphic retractile polyps, the autozooids not exceeding 1 mm in length, the much smaller siphonozooids scattered irregularly among the autozooids; with abundant densely spiculate cœnenchyma, traversed by three longitudinal central canals passing down into the trunk; with smooth hyaline spicules bearing peculiar digitiform terminal processes, and showing very characteristic annulations, especially near the ends.

Deep-Sea Alcyonaria from Indian Ocean.†—J. Arthur Thomson and W. D. Henderson make a preliminary report on a collection of deep-sea Alcyonarians dredged by R.I.M.S. 'Investigator' in the Indian Ocean. About 15 new forms are noted, e.g. *Clavularia decipiens*, growing on a silicious axis, which is probably a large sponge fibre; *Sarcophytum fungiforme*, a large mushroom-shaped colony; several species of *Dasygorgia* or *Chrysogorgia*; *Primnoisis alba*; *Muricella bengalensis*; and *Scirpearella alba*.

Among the Pennatulacea there are new species of *Protocaulon*, *Protoptilum*, and *Stachyptilum*, and what seems to be a new genus (*Juncoptilum*) which is viviparous.

Primitive Germ-Cells of Ctenophora.‡—K. C. Schneider finds that in *Beroë ovata* the primitive germ-cells are large elements which originate in the mesoderm, diffusely within the gelatinous substance, and especially in the neighbourhood of the epithelium. They give origin to the muscle-cells and to the connective-tissue cells, as well as to the genital cells, and they may be called embryonic mesoderm-cells, and compared to Sollas' "archæocytes" in sponges.

Protozoa.

Dimorphism in the Nummulites.§—J. J. Lister finds that when a number of species of *Nummulites* are arranged in order of the sizes of the megalospheres, this coincides with the order of the volumes of the microspheric tests. In *Polystomella crispa*, the only member of the Nummulitidæ of which the details of the life-history are approximately known, the only mode of origin of the megalospheric form which has been observed is by an asexual process of reproduction, from a microspheric parent. Hence it would appear that in this mode of reproduction the size of the offspring is approximately proportional to the volume of protoplasm of the parent.

The microsphere probably arises as a zygote formed by the conjugation of the zoospores produced by the megalospheric individuals; and the size of the microsphere is found not to vary outside 15–20 μ in the four species in which it has been measured. The two modes of reproduction are thus contrasted in the size of the offspring.

* Ann. Nat. Hist., xv. (1905) pp. 361–5 (1 pl.). † Tom. cit., pp. 547–57.
‡ Zeitschr. wiss. Zool., lxxvi. (1904) pp. 389–99 (1 pl.).
§ Proc. Cambridge Phil. Soc., xiii. (1905) pp. 92–3.

Dimorphism in English Species of Nummulites.*—J. J. Lister has examined the characters of *Nummulites lævigata* Brug., *N. variolaria* Lam., and *N. elegans* Sow., with respect to dimorphism. His results are in complete accord with the conclusion that the species of *Nummulites* are dimorphic. We have, however, to recognise that while in many species of the genus the microspheric form attains a much larger size than the megalospheric, in others the two forms attain the same size—a condition which is indeed the rule in the great majority of the Foraminifera.

Notes on Infusorians.†—W. D. Henderson communicates a number of brief notes on a large number of Infusorians collected round Freiburg. Over eighty species were collected in a short time. Most of the notes corroborate previous descriptions, but a few observed differences of interest are recorded, e.g. the apparent absence of a micronucleus in *Spirostomum ambiguum*.

Flagellata in Blood of Fresh-water Fishes.‡—Keysselitz reports on a large number of cases in which he has found in the blood and lymph of fresh-water fishes representatives of the genera *Trypanoplasma* and *Trypanosoma*.

Movements of Gregarines.§—Howard Crawley discusses the various movements of Gregarines, and lays all emphasis on the "myocyte," the layer of fibrils which encircles the animal in a slightly spiral direction, with circular fibres united by longitudinal and diagonal connectives, the whole system forming a net. After discussing the various interpretations and stating his observations, he comes to the conclusion that all the motor phenomena which the Polycystidea display may be directly credited to contractions of the myocyte, with the possible exception of the amœboid movements of certain species, and the rotation.

Metameric Cytoplasm in Gregarine.‖—L. Léger describes from the intestine of the larva of *Ceratopogon solstitialis* Winn., from marshes near Cavalière, a remarkable new cellular type, which he names *Tæniacystis mira* g. et sp. n. It is a Gregarine of long, worm-like shape, whose cytoplasm is divided into numerous compartments by transverse septa; it resembles a small Cestode. The number of segments increases with the size of the animal, which reaches 300 μ. As many as twenty-nine segments have been observed. Anteriorly the shape undergoes change of form, becoming beak-shaped: this is probably for adhesion. A single spherical nucleus is present in the sixth or seventh segment. The cell is covered by a thin cuticle, and there is no ectoplasmic layer.

Anisogamy in Monocystis.¶—L. Brasil finds that, contrary to the general view, conjugation in *Monocystis* is anisogamous, although not to the same degree as in *Stylorhynchus* and *Pterocephalus*. Isogamy, he considers, is probably the exception rather than the rule in Monocystids.

* Proc. Cambridge Phil. Soc., xiii. (1905) pp. 1–2.
† Zool. Anzeig., xxix. (1905) 24 pp. and 6 figs.
‡ SB. Ges. Natur. Freunde (Berlin, 1904) pp. 285–96.
§ Proc. Acad. Nat. Sci. Philadelphia, 1905) pp. 89–99.
‖ Comptes Rendus, cxl. (1905) pp. 524–6. ¶ Tom. cit., pp. 735–6.

Biology of Piroplasma canis.*—G. Nuttall reviews the known facts of geographical distribution, pathological effects, and mode of dissemination of *Piroplasma canis*. Cattle, sheep, horses, and man all serve as hosts for this parasite. It occurs in the blood in all parts of the body, most abundantly in the internal organs, within the blood-cells, and also free in the plasma. The author infected dogs in England, where piroplasmosis does not occur, through the medium of ticks (*Hæmophysalis leachi*), the reputed intermediate host in Africa.

Trypanosomes of Nagana and Mal de Caderas.†—W. L. Jakimoff finds that infection with these parasites causes very acute sickness in mice and rats; in dog, fox, guinea-pig, rabbit, and cat, the disease is slower, lasting from one to six weeks; frogs and pigeons are immune. The virulence of the trypanosome is increased by frequent passage through the animal organism, while extremely small numbers are sufficient to accomplish infection. Besides the blood, the cerebro-spinal fluid, pleural, peritoneal, and pericardial exudations, as well as other body fluids contain the infection substance. House-flies do not act as transmitters of these diseases.

Leucocytozoan of the Dog.‡—C. A. Bentley describes what seems to be a new and hitherto undescribed parasite of the leucocytes of the dog. The subjects were of English breed, born in Assam, and showed a slight anæmia, and some little febrile disturbance. It may be that the parasite is a Hæmogregarine, which would be remarkable in the blood of a mammal and in the leucocytes thereof.

Cœlosporidium Blattellæ.§—Howard Crawley describes this new Sporozoon, one of the Haplosporidia, which occurs in great abundance in the Malpighian tubules of the so-called Croton bug, *Blattella germanica* L. He gives an account of its life-cycle as far as he has been able to trace it.

Diseases of Fishes.‖—O. Fuhrmann discusses in a brief note the causes of some of these. Diseases due to bacteria and sporosoa are *furonculose* of Salmonids, the loosening of scales in white-fish, bubonic disease of barbels, and small-pox of carp. An interesting epidemic malady of the female sexual organs of the pike of Lake Neuchâtel is caused by a myxosporidian (*Henneguya psorospermica* var. *oviperda*). The disease destroying carp is probably caused by a parasite of the genus *Trypanosoma*, which causes sleeping sickness in man.

Pseudo-Hæmatozoa.¶—A. Laveran directs attention to a number of appearances which may be, and have been, mistaken for intra-corpuscular Hæmatozoa, e.g. (1) vacuolated corpuscles, common in anæmic subjects; (2) nucleated corpuscles, also frequent in anæmia; (3) granular ("mouchetée") corpuscles; and (4) hæmatoblasts.

* Journ. Hyg., iv. (1904) p. 219.
† Centralbl. Bakt. Parasitenk., xxxvii. (1904) pp. 668–78.
‡ Brit. Med. Journ., May 6, 1905, p. 988 (2 figs.).
§ Proc. Acad. Nat. Sci. Philadelphia, 1905, pp. 158–61 (6 figs.).
‖ Arch. Sci. Phys. et Nat., xix. (1905) p. 205.
¶ Comptes Rendus, cxc. (1905) pp. 1211–16 (4 figs.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

General Cytology.*—B. M. Davis continues his interesting "Studies on the Plant Cell," in which he is giving a general résumé and discussion of cell problems. In this part, No. 5 of the series, he deals with cells-unions, and nuclear fusions in plants.

Heterotype division.†—V. Grégoire and J. Berghs ‡ have made further observations on the exact meaning of the first apparent split which appears in the chromosomes of this division in microspore-mother-cells. They believe that in synapsis two threads become arranged side by side to form the thick spireme thread. The chromosomes are thus double in nature, but duality is not produced by the bending on itself of a segment of the spireme thread, as Dixon, Farmer and Moore believe, or in other words the double chromosomes are produced by the somatic chromosomes from the first lying side by side, not by these chromosomes joining end to end and later bending over parallel to one another. Berghs describes the process of formation of the double spireme thread in detail in *Allium fistulosum*.

Cell-Structure of the Cyanophyceæ.§—Alfred Fischer has brought forward a new work on this much-discussed subject. His most important points are that the "central body" contains large quantities of a carbohydrate (derived from the chromatophore), either glycogen, or anabænin which can be converted, at least partially, into glycogen or dextrin by treatment with acid. The mitosis which was observed by various workers is not a process by which chromatin is distributed to the daughter-cells, but a mere equal distribution of granules of an inert assimilatory product, or carbohydrates. The mitosis of the older observers is thus nothing more than carbohydrate-mitosis (kohlehydrat-mitose). The chromatin lately described by Olive, in the form of chromosomes and threads, is nothing more than anabænin which takes nuclear stains like chromatin. The interesting possibility that this carbohydrate-mitosis is the phylogenetic forerunner of the nuclear mitosis of higher plants, is suggested.

Cytology of Araiospora.‖—C. A. King has investigated the cytology of *A. pulchra*, a somewhat rare aquatic fungus first described by Thaxter, and placed doubtfully either in the Peronosporaceæ or Saprolegniaceæ.

* Amer. Nat., xxxix. (1905) pp. 217-68 (3 figs.).
† La Cellule, xxi. (1904) pp. 297-314. ‡ Tom. cit., pp. 384-397, pl. 1.
§ Bot. Zeit., lxiii. (1905) pp. 51-130, pls. 4-5.
‖ Proc. Boston Soc. Nat. Hist., xxxi. (1903) pp. 211-45, pls. 11-15.

... zoospores are formed by an ... strands which connect the ... vidual nuclei. When the ... included in the cell which ... arise between them. At ... meshed, patches arise in the ... the centre of the oogonium, ... ply-staining, fine-meshed mass. ... tinal walls into a great number ... view; the cells are bounded ... outer surface, which is directed ... oosphere is uninucleate. The ... No antheridial ... but only a single sperm nucleus ... papilla ... ridial tube was observed, but the ... peripheral cells ... which develops a tube from the ... invariably ... the oogonial wall. As the sexual ... and these beaks put out a pointed beak upon their ... until some may come in contact; actual fusion ... Araiospora ... point not ascertained, after the oospore ... is placed between *Pythium* and the ...

... of Wildiers.*—It was shown in 1901, by Wildiers, that ... is not able to develop and ferment rapidly in Pasteur's ... with sugar, unless a sufficient quantity of an extract obtained ... the same yeast is added to the solution. The unknown ... contained in this extract were termed by the discoverer ... A. Amand has made further investigations of this peculiar ... without throwing any light on the nature of the active ...nce.

Sexual Reproduction in the Rusts.†—A. H. Christman has investigated the early stages of development of the æcidium in *Phragmidium speciosum* and *Cæoma nitens*. The early stages of development ... the same as those described by Blackman for *Phragmidium violaceum*, but after the sterile cells have been cut off the "fertile cells" fuse in pairs by the breaking down of the upper part of the wall that lies between them. Only the cytoplasmic masses, however, fuse; the nuclei remain separate, but divide by the well known method of "conjugate" division, which takes place in the upper part of the cell; there the æcidiospores and intercalary cells are formed. Similar fused "fertile cells" were observed in *Uromyces Caladii*, but the early stages were not traced.

Structure and Development.

Vegetative.

Stipular Formations.‡—J. Schiller gives the results of his observations on the relation between true stipules and pseudo-stipules; the

* La Cellule, xxi. (1904) pp. 329–346.
† Bot. Gazette, xxxix. (1905) pp. 267–75, pl. 8.
‡ SB. K. Akad. Wiss., cxii. (1903; received May 1905) pp. 703–819 (3 ...

former are outgrowths from the leaf-base, while the latter are developed from the blade. Pseudo-stipules are distinguished not only by this difference of development, but in their occurrence. Whereas stipules are remarkably constant in their occurrence, pseudo-stipules are generally found on plants the leaves of which bear no stipules, and only on certain parts of such plants, where they perform some special function. Their function, like that of most true stipules, is associated with the protection of more delicate organs. The author finds that they occur on plants with lobed or pinnate leaves; either on the primary leaves of a shoot, or on the bracts and in the leaves in the vicinity of the flower region; more rarely are they found on the leaves of the whole plant, as in *Canarium*. Occasionally, as in *Anthyllis*, *Lotus*, and other members of the Papilionaceæ, both stipules and pseudo-stipules are present on one and the same leaf.

Reproductive.

Structure of the Flower in Cruciferæ.*—As a result of the study of the arrangement of the vascular bundles in the parts of the flower, Gerber considers the floral diagram of the typical crucifer to be as follows: S 2 + 2, P 4 (diagonal), St 2 + 4, G 2 + 2. The gynœcium is composed of four leaves, two valvular and sterile, two placental and fertile. These four leaves are concrescent by their margins, and in addition the two placental leaves are concrescent by their median nerve with the axis of the flower, causing a division of the ovary into two chambers.

Inflorescence of Boraginaceæ and Solanaceæ.†—W. Müller adds yet another to the numerous discussions on the character of the so-called boragoid inflorescence in these two families. While the greater number of writers on the subject, including De Candolle, Eichler, Celakovsky and Schumann have regarded the inflorescence as of a monochasial cymose type, others, including Schleiden and Goebel, have referred it, as a whole or in part, to a monopodial development. The present writer has studied the development of the inflorescence in species of the following genera of Boraginaceæ, *Tiaridium*, *Heliotropium*, *Symphytum*, *Mertensia*, *Myosotis*, and *Omphalodes*, and concludes that, generally speaking, it is a dorsiventral monopodium, with in some cases a tendency towards a dichotomous development. Similarly he finds that the inflorescence of *Hyoscyamus niger* is a dorsiventral monopodium.

Structure and Function of the Antipodal Cells.‡—P. K. Lötscher has investigated a number of species of seed-plants, and as a result distinguishes three anatomical-physiological types of antipodal cells. In the first type the antipodals show the lowest grade of differentiation, remaining as naked protoplasts or unattached cells. Their function consists mainly in the solution or absorption of the nucellus. To this type belong the orchids, Cruciferæ, Geraniaceæ, Linaceæ, Papilionaceæ, Primulaceæ, Polemoniaceæ, and Scrophulariaceæ. In the second type

* Comptes Rendus, cxl. (1905) pp. 1143–6.
† Flora, xciv. (1905) pp. 385–419 (11 figs. in text).
‡ Tom. cit., pp. 213–62 (2 pls.).

the cells are well differentiated and form a roundish cell-complex, the chief function of which is the conversion of the material stored in the embryo-sac. It is represented by the Gramineæ, Araceæ, Ranunculaceæ, Mimoseæ, Cæsalpinieæ, and occurs also, in combination with the third type, in the Liliaceæ, Iridaceæ, Zingiberaceæ, Boraginaceæ, and Solanaceæ. In the third type the cells form individually or together an elongated structure serving as haustoria for the embryo-sac; this type is exemplified mainly in Rubiaceæ and Compositæ.

Apogamy in Alchemilla.*—E. Strasburger comes to the following conclusions as the result of the study of this phenomenon in several species of the section *Eu-Alchemilla*. Thirty-two bivalent chromosomes are present at the reduction division of the pollen-mother-cells. In the ovule of apogamous species one or several archesporial cells appear as embryo-sac mother-cells. Their nuclei pass through the prophase stage of the reduction division as far as the synapsis stage. At this point the embryo-sac mother-cell becomes vegetative, its nucleus passing over from the synapsis into the typical method of division. The products of division of the thus altered archesporium cell are due to a vegetative, not to a generative process. They must be regarded not as the beginning of a new generation, as macrospores, but as tissue cells of the parent; and the resulting development is apogamous. The embryo-sacs which are formed from this tissue contain an apogamous egg-cell, the nucleus of which has a vegetative number of chromosomes, and the embryo is an apogamous development of this egg-cell.

Some of the subnival species have normal pollen, and these also develop in their ovules, by the process of reduction division, macrospores from embryo-sac mother-cells. The embryo-sac which develops from the macrospore contains a generative egg with a reduced number of chromosomes in the nucleus, and produces an embryo only as the result of fertilisation. The author also finds that the normal sexual species are chalazogamic, and that some of them hybridise. He suggests that excessive mutation has caused the weakening of the sexual power in the Eu-Alchemilleæ, and with failure of fertilisation apogamous reproduction has been adopted. The genera *Rubus* and *Rosa*, in spite of their strong polymorphism, have hitherto remained sexual; the author finds that the macrospore develops from the embryo-sac mother-cell by a process of reduction division, and the egg is a generative one. It is also pointed out that diœcism has in many cases formed the stimulus to the assumption of apogamy, the separation of male and female individuals tending to a suppression of fertilisation.

Notes on the Fruits of Opuntia.†—J. W. Toumey has studied various species of this genus, which is evidently of comparatively recent origin and development. Owing to the instability of the characters available for the systematist, no one has been able to make a satisfactory taxonomic arrangement of the species, nearly one hundred of which (including varieties) have been described from the arid regions of the south-western United States and north-western Mexico. The shoot is

* Jahrb. wiss. Botan., xli. (1904) pp. 88–164 (4 pls.).
† Bull. Torrey Bot. Club, xxxii. (1905) pp. 235–9 (2 pls.).

more or less condensed and fleshy; the roots are generally of two sorts, long surface ones for rapid absorption of moisture, and short deeper ones for support. As regards the fruit, from the study of many species from the standpoint of structure, from the similarity in external appearance between the fruit and the ultimate vegetative branches, and from teratological evidence, the author concludes (1) that the fruit is caulome in structure; (2) Its caulome nature is probably of recent development; (3) It has become caulome by its once superior ovary receding into a vegetative branch, thus making it at present inferior; (4) The branch, which now becomes the ovary, is usually modified and ripens into the structure which we term the fruit. It may, however, become but little modified, resembling the ultimate branches, and continuing as a vegetative part of the plant.

Throughout the genus the fruit in its early development bears numerous leaves in the axils of which vegetative branches as well as flowers occur. The fruit of the flat-stemmed species deviates farthest in form from that of the normal vegetative branch; but in several of these the structure containing the seeds is sometimes large and flattened, like the normal vegetative branches. In such cases, however, the whole member does not become pulp-like, change colour and ripen. Only that part immediately surrounding the seeds ripens as the seeds mature; the remainder continues as a vegetative part of the plant. When the fruit is sterile it often does not ripen at all, but remains on the plant for months after the normal fruits have matured. These sterile fruits sometimes produce normal flattened branches during the second season.

PONZO, A.—L'autogamia nelle piante fanerogame. (Autogamy in seed-plants.) [Includes observations on species of *Ranunculus*, *Matthiola*, *Brassica*, *Gypsophila*, *Silene*, *Calendula*, *Linaria*, *Satureia*, *Euphorbia*, *Crocus*, *Narcissus*, and *Scilla*.] *Bull. Soc. Bot. Ital.*, 1905, pp. 73–87.

Physiology.

Nutrition and Growth.

Soil Inoculation for Leguminous Plants.*—G. T. Moore has made an important contribution to our knowledge of the behaviour of nitrogenous fixing organisms, and one of considerable economic value. He finds that the nitrogen is fixed by the tubercle-forming bacteria within their bodies. This was determined by cultures in flasks containing nutrient solutions without nitrogen, when no increase of nitrogen was found in the solution, but a marked increase in the organisms themselves. The organism is therefore a parasite. Ultimately the plant overpowers the parasite, and uses the fixed nitrogen. Grown in nitrogenous media the organism lost both its power of infecting leguminous plants and its power of fixing nitrogen; whereas in non-nitrogenous media both these properties were retained. A lack of recognition of these facts serves probably to explain previous failures by Nobbe to obtain for economic use pure cultures of this organism. The author has devised a method of putting up for distribution pure cultures of *Pseudomonas radicicola*,

* U.S. Dept. of Agric., Bureau of Plant Industry, Bull. 71 (1905) 72 pp., 10 pls. See also Bot. Gazette, xxxix. (1905) pp. 371–2.

grown in nitrogen-free media and dried on cotton immersed in the culture. These cultures are sent out by the Department of Agriculture, together with packages of nutrient salts to multiply the organism; the culture thus obtained is used to inoculate the seed or soil.

Irritability.

Immunity of Plants to their own Poison.*—G. J. Stracke, as a result of a number of observations with various herbaceous plants, concludes that in some cases the cells of the tissues of the higher plants possess an immunity to their own poison when presented in a chemically pure state, but that this is not a general rule. Moreover, such cells may show immunity to other injurious substances, which may or may not be chemically related to the poison which they themselves contain. Experiments made with the liquids expressed from the cells suggest the possibility that these liquids may contain substances which are more injurious to the cells in question than to others. It is perhaps not a matter of indifference for the life of the protoplast that the action of the poison be directed from the vacuole to the external layer of the protoplast. Or it is quite possible that in many cases a cell-fluid, originally innocuous, acquires after its isolation toxic properties as the result of decompositions set up by enzyme action.

General.

Experiments on the Attraction of Bees by Flowers.†—Joséphine Wery gives an historical account of the work of previous observations on the subject of the attraction of bees by flowers, followed by a description of experiments made by herself in two different seasons in the Brussels Botanic Garden. The author concludes that the brightly coloured parts of the flower are the chief attraction, the honey and the perfume apart from the colour having but very slight attractive power. If the total attractive power of the flower be represented by 100, the effect of the form and colour will be represented by about 80 and that of the other factors—presence of pollen, nectar and perfume, taken together—by about 20.

Relation between Ants and Plants.‡—E. Ule gives a catalogue of the plants collected by himself in the Amazon region with which ants were found associated. The collection comprised twenty-eight species of ants (determined by Professor A. Forel) and more than thirty associated plants. The plants are included in the following families: Araceæ (*Anthurium*), Bromeliaceæ (*Tillandsia*), Moraceæ, Polygonaceæ (*Triplaris*), Leguminosæ, Euphorbiaceæ (*Sapium*), Melastomaceæ, Boraginaceæ (*Cordia*), and Rubiaceæ (*Duroia*).

Fossil Fruits from the Tertiary Lignites.§—G. H. Perkins describes the results of his study of a large collection of fossil fruits

* Arch. Néerland Sci., Ex. and Nat., ser. 2, x. (1905) pp. 8–61.
† Bull. Cl. Sci. Acad. Roy. Belg., 1904, pp. 1211–61.
‡ Flora, xciv. (1905) pp. 491–7.
§ Rep. State Geologist Vermont, 1904, pp. 174–212 (7 pls.). See also Bot. Gazette, xxxix. (1905) p. 371.

from the lignites of Brandon, Vermont, U.S.A. One hundred and eighteen species are recorded, and many new forms of more or less doubtful affinities are described, including several new genera, such as *Monocarpellites* (11 species), *Hicoroides* (5 species), *Bicarpellites* (5 species), *Brandonia*, *Rubioides*, *Sapindoides* (6 species) and *Prunoides*.

Explorations in Georgia.*—Roland Harper gives an account of his botanical work in the coast plain of Georgia in 1903. He studied especially the Altamaha Grit, one of the most botanically interesting and extensive geological formations in the State, covering an area of at least 11,000 square miles. It is a gently rolling region, nine-tenths of which in its natural condition is pine-barrens, and the remainder mostly swamps, which border the numerous streams and sand-hills which occur along most of the creeks and rivers. The author gives notes on the more interesting plants, including a bibliographical account of *Canna flaccida*, a species confined to the south-eastern United States, about which there has been some confusion, both as to name and geographical distribution.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Index Filicum.†—C. Christensen publishes the first fascicle of an index to all the genera and species of ferns and fern-allies described between 1753 and 1905, with their synonyms and geographical distribution. The manuscript is all ready for printing, and will make a book of about 750 pages, in 11 or 12 parts, issued in quick succession. The author has been engaged upon the preparation of the Index for many years, and has taken every precaution to ensure the accuracy of his citations and dates. The work is divided into three sections: I. a systematic enumeration of the genera based on the arrangement elaborated in Engler and Prantl's "Die Natürlichen Pflanzenfamilien." II. An alphabetical enumeration of the species and synonyms published between 1753 and 1905, including garden names. III. An alphabetical catalogue of literature, wherein new genera and species are described or examined.

Affinities of Ophioglossaceæ and Marsiliaceæ.‡—D. H. Campbell discusses in detail F. O. Bower's view that the whole spike of *Ophioglossum* is the equivalent of a single sporangium of *Lycopodium*, and that all the pteridophytes are reducible to a common strobiloid type, as seen in the Lycopods or Equisetaceæ. Campbell, on the contrary, holds to his own published view that the direct origin of the Ophioglossaceæ was from an Anthoceros-like prototype, the hypothetical ancestral form being almost realised in *Ophioglossum simplex*, with its long stalked sporangiophore, and scarcely traceable sterile segment. Further, he traces in detail the close relationship between the Ophioglossaceæ and

* Bull. Torrey Bot. Club., xxxii. (1905) pp. 141–71 (5 figs.).
† Copenhagen: Hagerup, 1905, Fasc. i., pp. 1–64.
‡ Amer. Nat., xxxviii. (1904) pp. 761–75.

Marattiaceæ, and holds that the former should be associated with the latter among the eusporangiate ferns. As to the Marsiliaceæ, he thinks that recent work justifies the assumption that their relationship with the Schizæaceæ is not very remote, the resemblance between the sporocarp of *Marsilia* and the fertile leaf-segment of *Schizæa* being specially marked.

Asplenium Seelosii Leybold.*—M. Calegari has found this rare fern near the village of Rasa, on the mountain called "Campo dei Fiori," a hill to the north of Varese, in Lombardy. It occurred at a height of 850 m., considerably lower, therefore, than the lowest limit given by Hartinger and Dalla Torre (1300–2000 m.). The author believes that the record of this species from Istria, found in certain books, is erroneous; and he points out that in Arcangeli's "Compendio," the name of Salorno, a locality for *A. Seelosii* between Trento and Balzano, has, by a printer's error, been changed to Salerno.

ANONYMOUS—**Notes on Fern Culture.** *Bull. Dept. Agric. Jamaica*, iii. (1905) pp. 71–2.

ARBER, E. A. N.—**A new feature in the Morphology of the Fern-like Fossil Glossopteris.** *Rep. Brit. Ass. Adv. Sci.* 1904 (1905) p. 781.

" " **On the Sporangium-like Organs of Glossopteris Browniana Brongn.**
[Morphology of these organs, evidence of their connection with this genus, and historical sketch.]
Quart. Journ. Geol. Soc., lxi. (1905) pp. 324–38 (2 pls.).

BARSANTI, L.—**Secondo contributo allo studio della flora fossile di Jano.** (Second contribution to the study of the fossil flora of Jano.]
Atti Soc. Tosc. Sc. Nat., xx. (1904) pp. 115–31 (fig.).

BOODLE, L. A.—**On Reduction of the Gametophyte in Todea.**
Rep. Brit. Ass. Adv. Sci. 1904 (1905) p. 781.

BERTRAND, C. E., & F. CORNAILLE—**Observations on Structure of the Leaf-trace of Inversicatenate Filicinæ.** *Tom. cit.*, pp. 778–80.

CHRIST, H.—**Quelques remarques concernant une collection de Fougères du Bhotan.** (Some remarks concerning a collection of ferns from Bhotan.)
Ann. Conserv. et Jard. Bot. Genève, 1904, pp. 330–2.

CLUTE, W. N.—**The Round-leaved Maiden-hair (Adiantum reniforme).**
Fern Bulletin, xiii. (1905) pp. 49–50 (1 pl.).

" " **What constitutes a species in the genus Isoetes?**
[A discussion of the value of characters, drawn from habitat, trunk, stomata, leaves, indusium, sporangia, bast-bundles, spores, and soil. Spore-markings appear to be the least variable character for the North American species.]
Tom. cit., pp. 41–7.

DAVENPORT, G. E.—**A new type of Aneimia.**
[Description of *A. Brandegeea* Davenport, a new species from Mexico, remarkable for the conversion of its lower pinnæ into sporophylls, and thereby constituting a new section of the genus.]
Tom. cit., pp. 18–21 (1 pl.).

EATON, A. A.—**Notes on Isoetes.**
[Description of a new species and two new varieties.] *Tom. cit.*, pp. 51–3.

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* Malpighia, xix. (1905) p. 121.

EGGLESTON, W. W.—**The Fern Flora of Vermont.**
[List of 82 species and varieties of ferns and fern-allies, with notes on their distribution.] *Tom. cit.*, pp. 33–41.

FLETT, J. B.—**Observations on Lycopodium Selago-lucidulum.**
[*L. Selago* at a high altitude grades imperceptibly into the large forest form. *L. lucidulum*, in North America.] *Tom. cit.*, p. 48.

FORD, S. O.—**The Anatomy of Psilotum triquetrum.**
Rep. Brit. Ass. Adv. Sci. 1904 (1905) p. 780.

GRAND'EURY—**Sur les graines trouvées attachées au Pecopteris Pluckeneti Schlot.** (On the grains found attached to *Pecopteris Pluckeneti* Schlot.) *Compt. Rend. Acad. Sci. Paris*, cxl. (1905) pp. 920–3.

GUFFROY, CH.—**Les Aspidium aculeatum et A. Lonchitis, constituent-ils deux espèces distinctes?** (Do *A. aculeatum* and *A. Lonchitis* constitute two distinct species?) *Bull. Soc. Bot. France*, lii. (1905) pp. 77–84 (1 pl.).

HAMILTON, A.—**On abnormal developments in New Zealand Ferns.**
Trans. Proc. New Zealand Inst., xxxvi. (1904) pp. 334–72.

HARPER, R. M.—**The Fern Flora of Georgia.**
[An annotated list of 58 Pteridophytes, with an account of the geological and botanical features of the State of Georgia.] *Fern Bulletin*, xiii. (1905) p. 1–17.

HIERONYMUS, G.—**Aspleniorum species novæ et non satis notæ. Beschreibungen von neuen Arten und Bemerkungen zu älteren Arten der Gattung Asplenium.** (New and insufficiently-known species of *Asplenium*. Descriptions of new species and remarks on old species of the genus *Asplenium*.)
[*A. galipanense* is split off from true *A. Karstenianum*. Both are described in great detail.] *Hedwigia*, xliv. (1905) pp. 193–8 (1 pl.).

HILL, E. J.—**Equisetum scirpoides in Illinois.**
[Note on the distribution of the species.] *Fern Bulletin*, xiii. (1905) p. 21–3.

HILL, T. G.—**On the presence of Parichnos in Recent Plants.**
[Comparison of certain mucilage-cavities in *Isoetes hystrix* with the parichnos of *Lepidodendron*, etc. *Rep. Brit. Ass. Adv. Sci.* 1904 (1905) p. 780.

KIDSTON, R.—**On the Divisions and Correlation of the Upper Portion of the Coal-Measures, with special reference to their Development in the Midland Counties of England.**
[Contains several lists of fossil ferns, utilised for the classification of the different strata.] *Quart. Journ. Geol. Soc.*, lxi. (1905) pp. 308–23

KLUGH, A. B.—**The Flora of the Puslinch Lake District.**
Guelph Herald, No. 18 (1904); *Fern Bulletin*, xiii. (1905) p. 27.

KÖHNE, W.—**Sigillarienstämme, unterscheidungsmerkmale, Arten, geologische Verbreitung.** (Distinguishing characteristics, species, and geographical distribution of the stems of *Sigillaria*.) *Dissert.* (Erlangen, 1904) 72 pp.

KÜMMERLE, J. B.—**Der vierblättrige Kleefarn in der Flora von Budapest.** (*Marsilia quadrifolia* in the flora of Budapest.)
[Specimens of this plant exist in the Hungarian National Museum. It was gathered formerly in the Rákos brook, but cannot now be found.] *Magyar Bot. Lapok*, iii. (1904) pp. 322–9.

MAXON, W. R.—**A New Botrychium from Jamaica.**
[The description of a new species, *B. Underwoodianum*, belonging to the *ternatum* group and most nearly related to *B. Jenmani* Underw. and *B. decompositum* Mart. and Gal. The type of the new species is preserved in the Herbarium of the New York Botanical Gardens.] *Bull. Torr. Bot. Club*, xxxii. (1905) pp. 219–22 (1 pl.).

PARISH, S. B.—**Ophioglossum californicum in Central California.**
Fern Bulletin, xiii. (1905) p. 49.

C.—**Asplenium Trichomanes in Maine.** *Rhodora*, vii. (1905) p. 13.

PEOLA, P.—**Sulla Flora carbonifera del Piccolo S. Bernardo.** (On the carboniferous flora of the Little St. Bernard.) *Mem. Carta Geol. Italia*, xii. (1904) 24 pp. (1 pl.).

PRAIN, D.—**Flora of the Sundribuns.**
[Contains some Pteridophyta.] *Rec. Bot. Surv. India*, ii. (1903) pp. 361–5.

RIPPA, G.—**La Peteridofite raccolte da G. Zenker al Congo.** (The Pteridophyta collected by G. Zenker on the Congo.) *Bull. Ort. Bot. Napoli*, ii. (1904) pp. 109–14.

ROBINSON, B. L.—**A Connecticut Station for Lycopodium Selago.**
Rhodora, vii. (1905) p. 20.

ROTA-ROSSI, G.—**Alcune considerazioni sulla ontogenia delle cormofite vascolari.** (Some views on the ontogeny of the vascular cormophytes.)
Atti Ist. Bot. Pavia, x. (1904) 4 pp., 1 pl.

RUDOLPH, K.—**Psaronien und Marattiaceen. Vergleichend anatomische Untersuchungen.** (*Psaroniæ* and *Marattiaceæ*. Researches into their comparative anatomy.) *K. Akad. Wiss. Wien Sitz. Anz. Math. Nat.*, Feb. 16, 1905.

SCHAFFNER, J. H.—**Lycopodium porophilum in Ohio.**
Ohio Naturalist, v. (1905) p. 301.

" " **The Life-Cycle of a Heterosporous Pteridophyte.**
Tom. cit., pp. 255–60 (fig.).

SCOTT, D. H.—**A New Type of Sphenophyllaceous Cone from the Lower Coal Measures.**
[*Sphenophyllum fertile*, from Shore Littleborough, in Lancashire.] *Rep. Brit. Ass. Adv. Sci.* 1904 (1905) pp. 777–8.

" " **On the structure and affinities of fossil plants from the Palæozoic rocks. V. On a new type of Sphenophyllaceous cone (Sphenophyllum fertile) from the Lower Coal Measures.**
Proc. R. Soc. London, lxxiv. (1904) pp. 314–15;
Ann. of Bot., xix. (1905) pp. 168–9.

" " **What were the Carboniferous Ferns?**
Journ. R. Micr. Soc., 1905, pp. 137–49 (3 pls.).

SCOTT, J. G.—**History of Asplenium ebenoides [in North America].**
Germantown Independent Gazette, Jan. 13, 1905 (fig.).

STUBING, J.—**Een vreemde Varen: Platycerium alcicorne.**
[An exotic fern.] *De Natuur*, xxiv. (1904) pp. 365–6.

TAYLOR, A. P.—**How and where Ferns grow in South-West Georgia.**
[Field notes.] *Fern Bulletin*, xiii. (1905) pp. 53–60.

TERRY, E. H.—**Dicksonia pilosiuscula forma schizophylla in Vermont.**
Rhodora, vii. (1905) p. 99.

VAN HOOK, M. L.—**Illinois Ferns near Lake Michigan.**
[Field notes.] *Fern Bulletin*, xiii. (1905) pp. 23–5.

WACKER, A. H.—**Ecological Notes on Ohio Pteridophytes.**
Ohio Naturalist, v. (1905) pp. 295–7.

WEISS, F. E.—**The Vascular Supply of Stigmarian rootlets.**
Ann. of Bot., xviii. (1904) pp. 180–1 (fig.).

WHITE, D.—**The seeds of Aneimites.**
[The author describes and figures the seeds of the fossil *Adiantites*, which plant he removes in consequence to *Aneimites* Dawson. The fruits, which are true seeds, are named *Wardia fertilis*, and are borne singly, or rarely plurally, at the apices of lax, flexuose, ramose, and slightly dilated terminal extensions of the peripheral pinnæ. The group of hitherto supposed ferns to which these seeds belong is now to be referred to the Pteridospermæ of Oliver and Scott, the "Cycadofilices" of Potonié.]
Smithson. Miscell. Coll., ii. (1905) pp. 322–31 (2 pls.).

WHITE, D.—**Fossil plants of the group Cycadofilices.**
[Descriptions are given of ten types generally regarded as Cycadofilic, after which the author treats of certain types which are also probably Cycadofilic. Finally, he discusses shortly the origin of the group.] *Tom. cit.*, pp. 377–90 (3 pls.).

YABE, Y.—**Trichomanes Formosense et Loochooense.**
[A list of 15 species of *Trichomanes* collected by K. Miyake in Formosa and the Liukiu Islands, with descriptions of three new species—*T. formosanum*, *T. Miyakei*, and *T. liukiuense*.] *Tokyo Bot. Mag.*, xix. (1905) pp. 31–5 (1 fig.).

ZEILLER, R.—**Sur la découverte de stations nouvelles des Trichomanes radicans dans les Basses-Pyrénées.** (On the discovery of new localities for *T. radicans* in the Lower Pyrenees.) *Bull. Soc. Bot. France*, lii. (1905) pp. 65–7.

Bryophyta.

(By A. GEPP.)

Researches on some Liverworts.* — E. Lampa publishes further results of her studies on the Hepaticæ. She finds that the stem of a hepatic, whether thalloid or leafy, arises by division of a cell of the germinating filament, generally the apical cell, into three segments—not into four as is generally believed. The division takes place by the formation of two more or less vertical walls in the apical cell, dividing it into three; and from the third segment a typical growing point is formed by a further division into two. The author has never seen any instance of the quadrant-division described in literature. She has grown many cultures from spores, both under a top light and a side light, and she describes her results. She finds that the formation of germinating threads from the plant under unfavourable conditions of light is by no means confined to quite young stages of the plant, for she has observed such threads arising from large plants of Hepatics, as well as from fairly large fern-prothallia. The germinating filaments of Hepaticæ are compared with the protonema of mosses. The development of the following species from the spore is dealt with in detail :—*Duvalia rupestris*, *Riccia glauca*, *Pellia endiviæfolia*, *Blyttia Lyellii*, *Lophocolea heterophylla*. The author has also studied the question of the position of the sexual generation of Hepaticæ, and compares the youngest stage of the gametophyte of certain acrogynous Jungermanniaceæ with a similar stage in Mosses. She passes on to the thalloid and other Hepatics, and discusses the early stages of their development, the three-sided segmentation and the reduced foliar organs tristichously arranged, which are found in the early stage of *Marchantia* and other thalloid genera, but disappear subsequently. This tristichous development characterises the early stages of all Hepatics, though it disappears later in the thalloid forms. Fern-prothallia show signs of division into stem and leaf, the explanation of which is forthcoming from a study of the ontogenesis of Marchantiaceæ.

Moss-Sporogonium Compared with Fern-Plant.† — Leclerc du Sablon publishes an account of some researches on the development of the sporogonium of Mosses in continuation of Kienitz-Gerloff's work, and with a view to confirming Vuillemin's comparison of the moss-

* SB. K. Akad. Wiss. Math. Nat. Wien, cxiii. (1905) pp. 779–82 (4 pls.).
† Rev. Gén. Bot., xvii. (1905) pp. 193–7 (figs.).

sporogonium with the stem of Ferns. In particular he has studied the succession of segments cut off from the apical cell and their subsequent divisions; and also the formation of the sheath of parenchymatous tissue which surrounds the spores in the adult capsule. The material studied was *Funaria hygrometrica* and *Bryum nutans*. He shows in detail and with figures how the amphithecium and endothecium arise; and how in the former the subsequent differentiation is centrifugal, the outermost layer corresponding to epidermis being the last to be differentiated; and the innermost and oldest layer corresponds to the endodermis. The differentiation of the endothecium, on the other hand, is centripetal, its outermost and oldest layer being the sporiferous layer. The endodermis layer subsequently divides centripetally into three, and forms the outer spore-sac; and the layer outside it splits and forms air-spaces. The endodermis of fern-stems is comparable in that it retains a generative activity, employed in the formation of lateral roots, and in the stolons of *Nephrolepis* it splits into two or three layers. The epidermal layer in both the moss-sporogonium and the fern-stem is so slowly differentiated off that it is not comparable to the epidermis of Phanerogams.

Nematode Galls in Mosses.*—V. Schiffner has already published some information on this subject, and in the present paper he adds the result of further study. Professor Matouschek had found Nematode galls only on pleurocarpous mosses; those, excepting *Pterigynandrum filiforme*, were all hygrophilous species. The present author finds similar galls formed plentifully on *Dicranum longifolium*, *D. montanum*, *D. scoparium*, *D. majus*, and *Hypnum cupressiforme*. He is of opinion that the Nematode in question is *Tylenchus Davainii* Bast., or a nearly allied new species; and he is sure that the animal is not by any means particular as to the species of moss it attacks, but is passed on to any moss in the immediate neighbourhood. He also shows that the galls are not formed on the fertile shoots, as has been supposed, since in *Hypnum cupressiforme* they occur even on the apex of the main stem. He describes the galls themselves and their effect on the growth of the affected moss-plant.

New and Rare Scottish Mosses.†—J. Stirton publishes detailed descriptions of the following six new or little known British mosses gathered by himself at various times in Scotland:—*Plagiothecium Kinlayanum*, *Campylopus pergracilis*, *Ceratodon vialis*, *Barbula limosa*, *Ulota scotica*, *Isothecium persimile*; and adds brief notes on 14 other rare species collected in the Island of Skye.

Scottish Hepaticæ.‡—S. M. Macvicar publishes numerous additions to his census of Scottish Hepaticæ of 1904. There are 368 entries, arranged under the respective counties in which the plants were found. The largest contribution, 45 species, is from the Clyde Isles. Five are additions to the British flora—*Nardia Breidleri*, *Lophozia guttulata*, *Odontoschisma Macounii*, *Kantia sphagnicola*, *Scapania paludosa*; and three more are new to Scotland.

* Hedwigia, xliv. (1905) pp. 218–22.
† Ann. Scot. Nat. Hist., 1905, pp. 104–8. ‡ Tom. cit., pp. 108–16.

Hepaticæ from Florida.*—A. W. Evans publishes some notes on new or noteworthy Hepaticæ from southern Florida, based on collections made under the direction of the New York Botanical Garden. The majority of specimens were gathered in the region south of Miami. The author remarks on the intimate relationship which exists between the hepatic flora of Florida and that of the West Indies, more than half the species of the collections under discussion being common to both regions. Three new species are described, *Plagiochila Smallii*, *Cololejeunea diaphana*, and *Lejeunea floridana*. Six others are here definitely recorded for the first time from the United States.

ALLEN, C. E.—**Some Hepaticæ of the Apostle Islands.**
[List of 21 species gathered on these islands of Lake Superior.]
Trans. Wisconsin. Acad., xiv. (1904) pp. 485–6.

ARNELL, H. W.—**Phænological observations on Mosses.**
[The author shows how the species of *Polytrichum* may be divided into two groups, according to the time required for the development of their sporogonia. He appeals to bryologists to collect records of the dates when some 32 selected species bloom and ripen their spores, and gives instructions as to how these observations should be made. The dates and times vary with the latitude and longitude. The author gives a table of comparative results for Sweden and Germany, selected from papers published by himself in 1875, and by A. Grimme in 1903.]
Bryologist, viii. (1905) pp. 41–4.

BAUER, E.—**Bryotheca Bohemica, Bemerkungen zur dritten Centurie, ein Beitrag zur Kenntnis der Laub- und Lebermoose Böhmens.** (Bohemian moss-flora: remarks on Century III., a contribution to a knowledge of the mosses and liverworts of Bohemia.)
[Critical remarks on and corrections of the third fascicle of exsiccati, published in January 1902.] *SB. Deutsch. Nat.-Med. Ver. Böhmen, "Lotos," Prag*, xxiv. (1904) pp. 134–43.

BLONSKI, FR.—**Conomitrium Julianum (Savi) Montg. ante portas.** (*Conomitrium julianum* at Posen.) *Zeitschr. Naturw. Abt. (Bot.) Deutsch. Gesell. Kunst. u. Wiss. Posen*, xi. (1904) Heft i.

BRITTON, E. G.—**Bryological notes. II. Some changes in generic names.**
[*Neckera domingensis* C. M. is made the type of a new genus, and named *Pseudo-Cryphæa flagellifera*; *Neckera abietina* Hook. is made the type of the new genus *Dendroalsia*, which takes for its second species *Leptodon circinalis* Sull., and for its third species *Alsia longipes* Sull. and Lesq.; *Macouniella* Kindb. is reduced, and its species restored to *Antitrichia*. Two new American species of *Erpodium* are described.]
Bull. Torrey Bot. Club, xxxii. (1905) pp. 261–8.

" " **Notes on Nomenclature. V.**
[Gives the synonymy of *Fissidens decipiens*, and shows that *F. floridanus* is identical, and must be suppressed.]
Bryologist, viii. (1905) p. 49.

CARDOT, J.—**Notes on some North American Mosses. II.**
[*Grimmia lamellosa* C. M. is the same as *G. subsulcata* Limpr. *Papillaria pendula* R. et C. is known from Java under the name *Neckera capilliramea* C. M., and from China and Japan. *Anomodon Toccoæ* is the type of a new genus, *Herpetineuron*. A variety of the wide-spread *Thuidium glaucinum* of the East Indies is now recorded from Louisiana.] *Bryologist*, viii. (1905) pp. 49–51.

* Bull. Torrey Bot. Club, xxxii. (1905) pp. 179–91 (1 pl.).

CARDOT, J.—**Notice préliminaire sur les Mousses recueillies par l'Expédition antarctique suédoise. Deux genres nouveaux de Mousses acrocarpes.** (Preliminary notice on the mosses gathered by the Swedish Antarctic Expedition. Two new genera of Acrocarpous mosses.)

[These plants were collected by C. Skottsberg in South Georgia. One is like *Distichium*, but has pentastichous leaves: it is called *Pseudodistichium austro-georgicum*. The other, *Skotsbergia paradoxa*, is allied to *Angstrœmia*, but has an asymmetric capsule, and a very remarkable asymmetric peristome formed of two dissimilar halves—a fact hitherto unknown in the Mosses.]

Rev. Bryolog., xxxii. (1905) pp. 45–7.

" " **Quelques mousses nouvelles pour la flore Belge.** (Some mosses new to the Belgian flora.) *Bull. Soc. Roy. Bot. Belgique*, 1904, pt. 2 (6 pp.).

CLAASSEN, E.—**Key to the Liverworts recognised in the sixth edition of Gray's "Manual of Botany."**

[This key to the genera aims at simplifying the determination of the hepaticæ of the north-eastern United States described in Gray's Manual. Other characters have been added to those of the perianth, in order that the genus of sterile plants may be recognised.]

Ohio Naturalist, v. (1905) pp. 312–15.

COZZI, C.—**Frammento di briologia milanese.** (Fragment of Milanese bryology.) *Boll. Nat. Siena*, xxiv. (1904) pp. 109–12.

DOUIN, I.—**Hépatiques nouvelles pour la France.** (Hepatics new for France.)

[Notes on *Scapania calcicola* and *S. obliqua*, their resemblances, differences, and relations to other species.] *Rev. Bryolog.*, xxxii. (1905) pp. 47–51.

EICHLER, B.—**Conomitrium Julianum (Savi) Mont., nowy nabytek dla flory krajowej mchów liściastych.** (A novelty for the mossflora of the country.)

[In Polish.] *Wszechświat*, 1904, No. 17, p. 269.

FARMAR, L.—**Monoclea Forsteri.** *Knowledge and Sci. News*, ii. (1905) p. 78 (fig.).

FRIREN, A.—**Promenades bryologiques en Lorraine III.** (Bryological excursions in Lorraine.) *Bull. Soc. Hist. Nat. Metz*, 1904, 25 pp.

GÉNEAU DE LAMARLIÈRE, L.—**Supplément aux notes bryologiques sur les environs de Reims.** (Supplement to bryological notes on the environs of Rheims.). *Bull. Soc. Etude Sci. Nat. Reims*, xiii. (1904) pp. 14–44.

GONSE, E.—**Les Muscinées de la Somme de l'Herbier Boucher de Crèvecœur.** (The Muscineæ of the Somme in the herbarium of Boucher de Crèvecœur.)

[A list of 85 mosses and 14 hepatics, being a revision of an old list published in 1803.] *Bull. Mem. Soc. Linn. Nord France*, xv. (1901) pp. 258–65.

GROUT, A. J.—**Notes on Vermont Bryophytes.**

[List of mosses and hepatics not previously recorded for the State.]

Bryologist, viii. (1905) pp. 51–4.

HAGEN, J.—**Ein Beitrag zur Kenntnis der Brya Deutschlands.** (A contribution to a knowledge of the Brya of Germany.)

[Critical notes on the species, of which four are new to science, and three new to Middle Europe.]

K. Norske Vidensk. Skrifter. Trondhjem, 1904, No. 1.

" " **Musci Norvegiæ borealis. Bericht über die in nördlichen Norwegen von Arnell, Fridtz, Kaalaas und anderen 1886–1897, gesammelten Laubmoose. III.** (Mosses of Northern Norway. Report on the mosses gathered in Northern Norway by Arnell, etc., in 1886–97. Part III.) *Mus. Aarsk. Tromsö*, 1904, pp. 1–24, 241–382 (2 pls.).

HENRY, RENÉ.—**Au sujet de la station d'Epinal du Dilaena hibernica Dum.** (On the question of the record of *D. Hibernica* from Epinal.)

[This hepatic seems to have been wrongly reported from Epinal.]

Bull. Assoc. Vosgienne Hist. Nat. No. 7 (1904) pp. 110–112.

HERZOG, TH.—**Die Laubmoose Badens. Eine bryogeographische skizze.** (The Moss-flora of Baden: a bryogeographic sketch.)
[Continuation, *Eurhynchium* to *Amblystegium*.]
Bull. Herb. Boiss. v. (1905) pp. 465–480.

HOLZINGER, J. M.—**Musci acrocarpi Boreali-Americani.** (North American acrocarpous mosses.)
[With 100 dried specimens.]
Winona (1904) Fasc. 1–4.

" " **Two changes of name.**
[*Grimmia Flettii* and *Bryum Baileyi*.]
Bryologist, viii. (1905) p. 54.

JANZEN, P.—**Ein Beitrag zur Laubmoosflora Badens.** (A contribution to the moss flora of Baden.) *Mitt. Badisch. Bot. Ver.* (1905) pp. 29–40.

LANG, W. H.—**On the Reduction of the Marchantiaceous Type in Cyathodium.**
[Comparison of the structure of *C. fœtidissimum*, *C. aureonitens*, and *C. cavernarum*, with that of *Targionia*, etc.]
Rep. Brit. Ass. Adv. Sci. 1904 (1905) pp. 782–3.

LARTER, C. E.—**North Devon Cryptogams.**
[*Barbula gracilis*, a new record for the county.]
Journ. Bot., xliii. (1905) p. 188.

LEVIER, E.—**Appunti di briologia Italiana.** (Contributions to the Italian moss-flora.
[The first part of a list of new or rare mosses annotated and alphabetically arranged.] *Bull. Soc. Bot. Ital.* (1905) pp. 115–125.

LEWIS, F. J.—**Interglacial and Postglacial Beds of the Cross Fell District.** (Mention of a few mosses.) *Rep. Brit. Ass. Adv. Sci.* for 1904 (1905) pp. 798–9.

LIDFORSS, B.—**Ueber die Reizbewegungen der Marchantia-Spermatozoiden.** (On movement of spermatozoids of *Marchantia* in response to stimulation.)
[An account of some experiments with various solutions of albumens, globulins, nucleo-albumens, proteids and ferments, to determine the attraction they exert upon the spermatozoids of *Marchantia*.]
Jahrb. wiss. Bot., xli. (1904), pp. 65–87.

LUISIER, A.—**Revista de Bryologia 1903.** (Review of Bryology for 1903.)
Broteria, iii. (1904) pp. 254–63.

MAGNIN, A.—**Bryologie jurassienne. Recherches à faire sur les Mousses, les Sphaignes, et les Hépatiques du Jura.** (Bryology of the Jura. Researches to be made on the mosses, sphagna, and hepatics of the Jura.) *Arch. Flor. Jurass.*, vi. (1905) pp. 81–7.

" " **Additions aux recherches à faire sur les Mousses du Jura.** (Additional researches to be made on the mosses of the Jura.)
Tom. cit., pp. 92–3.

MATOUSCHEK, F.—**Additamenta ad Floram bryologicam Hungariæ. III. Determinationes muscorum a Dre. A. de Degen a. 1903 in Carpathis alibique lectorum.** (Additions to the moss-flora of Hungary. III. Determinations of mosses gathered by Dr. A. de Degen in the Carpathians and elsewhere.)
[Records arranged geographically; also a note on the gemmiferous threads of *Bryum capillare*.] *Magyar Bot. Lapok.*, iv. (1905) pp. 78–82 (fig.).

MAYNARD, C. J.—**Methods in Moss Study.** Boston (1905) 120 pp. (col. pls.).

MIYAKE, K.—**On the Centrosome of the Hepaticæ.**
[It is nothing but a centre of cytoplasmic radiation.]
Rep. Brit. Ass. Adv. Sci. 1904 (1905) p. 820.

NAVE, J.—**Collector's Handbook of Algæ, Desmids, Fungi, Lichens, Mosses, etc.**
[Instructions for their preparation and for formation of herbarium.]
London (1905) 214 pp. (figs.).

NĚMEC, B.—**Die Induktion der Dorsiventralität bei einigen Moosen.** (Induction of dorsiventrality in some mosses.)
[Observations on *Fissidens decipiens*, *Hypnum cupressiforme*, *H. cristacastrense*, *Hylocomium splendens*.]
Bull. Internat. Acad. Sci. Prague, ix. (1904) pp. 126–30.

NICHOLSON, W. E.—**Cephaloziella Limprichtii Warnst. in Britain.**
[Description of this plant, which was collected near Lewes in Sussex, and previously had been found at one place only, near Neuruppin in Brandenburg. It is paroicous and has entire bracts.]
Journ. Bot., xliii. (1905) pp. 186–7.

PARIS, E. G.—**Index Bryologicus.**
[Index to the genera, species, and varieties of the mosses of the world.] Paris, 1905, ed. II. vol. iii. fasc. 1, 2, pp. 1–136.

" " **Muscinées de Madagascar.** (Muscineæ of Madagascar.)
[A list of 11 mosses, 3 hepatics, and 7 lichens from Ambosika in eastern Madagascar. One new moss is described.]
Rev. Bryolog., xxxii. (1905) pp. 51–3.

PAUL, H.—**Beitrag zur Moosflora Oberbayerns.** (Contribution to the moss-flora of Upper Bavaria.)
Mitt. Bay. Bot. Ges. Erforsch. heim. Flora, 1905, pp. 447–8.

" " **Ueber den gegenwärtigen Stand der Torfmoosforschung in Oberbayern.**
(On the present condition of the investigation of the Sphagna in Upper Bavaria.)
Ber. Bay. Bot. Ges. Erf. heim. Flora, x. (1905) pp. 1–12.

PÉTERFI, M.—**Die Torfmoose Ungarns.** (The Sphagna of Hungary.)
[Monograph of 30 species.]
Növénytani Közlemények, iii. (1904) pp. 137–69.

" " **Einige Beiträge zur Moosflora des Kaukasus.** (Some contributions to the moss-flora of the Caucasus.)
Ann. Hist. Nat. Mus. Nation. Hungarici, ii. (1904) pp. 396–400.

SEBILLE, R.—**Une hypnée nouvelle pour les Alpes françaises. Amblystegium curvicaule.** (A Hypnaceous moss which is new for the French Alps.)
[Critical notes and figures of this high Alpine moss discovered last summer in Dauphiné. It is very closely related to *A. filicinum*.]
Rev. Bryolog., xxxii. (1905) pp. 41–4 (1 pl.).

STEPHANI, F.—**Hepaticæ amazonicæ ab Ernesto Ule collectæ.** (Hepatics of the Amazon river collected by E. Ule.)
[A list of 54 species from Brazil; 9 of them are described for the first time.]
Hedwigia, xliv. (1905) pp. 223–9.

TORKA, V.—**Während des Ausflugs am Aug. 14, 1904, bei Krammfliess und Promno in der Nähe von Pudewitz beobachtete Moose und Algen.** (Mosses and Algæ observed during the excursion of Aug. 14, 1904, to Krammfliess and Promno in the neighbourhood of Pudewitz.)
Zeitschr. Naturw. Abt. Deutsch. Ges. Kunst u. Wiss. Posen., xi. (1904).

TOWLE, P. M.—**Notes on the Fruiting Season of Catharinea.**
[Observations extending from March to December.]
Bryologist, viii. (1905) pp. 44–5.

WARNSTORF, C.—**Kryptogamenflora der Mark Brandenburg. Band ii., Heft 3. Laubmoose.** (Cryptogamic flora of Mark Brandenburg. Vol. ii., Part 3. Mosses.)
[Continuation: *Pohlia—Pterigynandrum*.]
Leipzig: Borntraeger, 1905, pp. 433–672 (pls.).

WARNSTORF, K.—**Neue europäische und exotische Moose.** (New European and exotic mosses.)
[Detailed descriptions of 17 species.]
Beih. Botan. Centralbl., xvi. (1904) pp. 237–52.

WHELDON, J. A.—**Bryum neodamense.**
[One station for this species on the South Lancashire coast has been destroyed. At another station, near Formby, fruiting specimens were found, a phenomenon not recorded in Britain for 30 years past.
Journ. Bot., xliii. 1905 (p. 188).

Thallophyta.

Algæ.

(By MRS. E. S. GEPP.)

Marine Algæ of Barbadoes.*—A. Vickers has spent two winters in Barbadoes collecting marine algæ, and publishes the results. She records 215 species, of which 56 were Chlorophyceæ and Cyanophyceæ, 34 Phæophyceæ, and 125 Florideæ. Among these she describes 16 new species, and includes 14 species already known to science but never hitherto recorded from the Antilles; thus adding 30 species to the flora of that region. Descriptions are given of the various places on the coast where the best collections were made, and the principal species growing at each of them are mentioned. Dredging and diving were employed as methods of collection, as well as shore collecting.

Parasitic Florideæ of California.†—W. A. Setchell gives a short and interesting summary of the parasitic Florideæ recorded from California since the publication of C. N. Nott's paper in 1897. A species of *Harveyella*, apparently *H. mirabilis* Schmitz, grows on *Gracilaria multipartita*, an *Actinococcus*, nearly related to *A. latior* Schmitz, occurs on *Gymnogongrus linearis* J. Ag., and a small parasite, possibly the type of a new genus, has been found by the author on *Mychodea episcopalis*. *Ceramium codicola* J. Ag. grows on *Codium mucronatum* var. *californicum*. The author shows also that *Erythrocystis Grevillei* J. Ag. is nothing more than *Ricardia Montagnei* var. *gigantea* Farlow; and *Chrysymenia dolichopoda* J. Ag. is *C. pseudodichotoma* Farlow. Finally a diagnosis is given of *Peyssonneliopsis*, a new genus of Squamariaceæ, differing only from *Cruoria* in its parasitic habit and consequent possession of rhizoidal filaments penetrating the host plant. The single species *P. epiphytica* Setchell and Lawson is parasitic on fronds of *Callymenia* sp. and was distributed as No. 1049 of the Phycotheca Boreali-Americana.

Leptosarca.‡—A. and E. S. Gepp give further details as to the structure of this new Antarctic alga, which was too diagrammatically figured in tab. 470 of "Journal of Botany." They specify the points in which the figures are at fault, and recapitulate the most striking features of the plant, viz. the extremely thin walls of the large interior cells and the monostromatic arrangement of the cortical layer; and they give cell measurements.

* Ann. Sci. Nat., lxxxi. (1905) pp. 45–66.
† Nuov. Notar., xvi. (1905) pp. 59–63.
‡ Journ. Bot., xliii. (1905) p. 162.

New Chlorophyceæ.*—M. A. Howe issues the first of his phycological studies and describes in it three novelties: *Halimeda scabra*, *Siphonocladus rigidus*, and *Petrosiphon adhærens*—the latter representing a new genus. *Halimeda scabra* differs from all the known species of the genus by having always strongly galeate-cuspidate peripheral utricles, and these spines are so large that they can be seen under a lens. The author finds the plant in various exsiccata under the name of *H. Tuna*, which it resembles in outward form. The fruit is described and figured. A septum usually cuts off the contents of the sporangium from the sporangiophore, recalling *Codium*. *Siphonocladus rigidus* has been found distributed under the name of *S. tropicus*, and is also closely related to *S. brachyartrus* Svedelius. *Petrosiphon* is a genus of Valoniaceæ, and is allied to *Siphonocladus*, but differs from it by having a flat, compact, crustaceous, more or less calcareous thallus. The last two species described are infested by a fungus, which appears to be parasitic.

Siphonocladus.†—F. Börgesen publishes some contributions to a knowledge of the genus *Siphonocladus*. He holds that the genus should be divided, and he forms from it a new genus *Cladophoropsis*. This is to include *S. membranaceus*, *S. fasciculatus*, *S. brachyartrus*, *S. voluticola*, *S. Zollingeri*, *S. modonensis*, *S. psyttaliensis*, and possibly some other species. The original genus, *Siphonocladus*, includes only *S. pusillus* and *S. tropicus*. (It may be added as a parenthesis that the plant published as No. 1031 in Phycotheca Boreali-Americana under the name of *S. tropicus*, is not that species but a new one, *S. rigidus* M. A. Howe.) The principal characters of *Siphonocladus* and *Cladophoropsis* are drawn up and printed side by side, and the author describes in detail a species of each genus, *S. tropicus* and *C. membranacea*. Figures are given of various points of structure.

Chlorochytrium.‡—F. S. Collins makes some interesting remarks on this genus and on *C. Lemnæ* in particular. He gives the distribution of the three marine species known in America, and then describes the life history of the fresh-water species, *C. Lemnæ*, which he has found in specimens of *Lemna trisulca* from Seabrook, New Hampshire. He recommends a search for *Chlorochytrium* in other host-plants than those already known.

Polarity and Organ-Formation in Caulerpa prolifera.§—J. M. Janse has made a series of careful experiments with a view to elucidating these points. Polarity in the cell being very difficult to investigate, he chose for experiment the large unicellular green alga, *Caulerpa prolifera*, and studied the streaming currents of its protoplasm both in the normal state and after local injuries. There are two sorts of current; one is green and nutritive; the other colourless and composed of meristem-plasm. Both are basipetal, and not easy to reverse by artificial means; but in leaves cut off and planted upside down the green current was more or less capable of reversal, the results being interfered with by the

* Bull. Torrey Bot. Club, xxxii. (1905) pp. 241–52 (5 pls.).
† Overs. Kgl. Dansk. Vidensk. Selsk. Forh., 1905, pp. 259–91 (13 figs. in text).
‡ Rhodora, vii. (1905) pp. 97–9.
§ Proc. K. Akad. Wetensch. Amsterdam, vii. (1905) pp. 420–35.

action of gravity. A local wound diverts the currents, and these endeavour to repair the injury. By judicious crushing, the formation of a transverse wall can be induced. Rootlets and rhizomes originate at points of junction of the white currents, the rootlets arising on the dark side, the rhizomes and leaves in the light. The leaves appear to arise independently of the meristem-current.

Zygospores of Desmids.*—J. A. Cushman describes and figures the zygospores of thirteen species and varieties of New England desmids. Two of these are new species, *Cosmarium pseudo-orbiculatum* and *Sphærozosma readingensis*, and three of them are new varieties. The author remarks on the necessity for further work on the various stages in the formation of zygospores, and the possibility that such a study may throw light on the validity of one or other of the two classifications, one based on form alone, the other on arrangement of cell-contents. The question also remains to be solved whether or not the zygospores of a single species are always constant in their characters.

Diatoms of the Orba.†—E. Morteo enumerates a list of forty-one diatoms collected in six samples taken during December 1904 and January 1905, from the Orba torrent between Casalcermelli and Portanuova. He found a peculiar form of *Pinnularia mesolepta*, which he thinks may be new. Specimens of *Synedra* were specially numerous.

Trochiscia moniliformis.‡—A. M. Edwards has examined this alga in its various stages of growth, and finds that the species has been described and figured by various authors under as many as twenty-nine different names. It occurs as a fossil as well as in a living state, and has been recorded from many parts of the world. In growth it resembles *Hyalodiscus*, while in spore-formation it resembles *Melosira*.

Algæ of the Weser District.§—J. Suhr begins a list of the algæ of the eastern hill district of the Weser, an area of about 1900 square kilometres, and one of the largest stretches of woodland country in Germany. The highest point is 517 m. In the present paper five species of Peridineæ are enumerated, and twenty-three Desmidiaceæ, with the localities where each occurs. As regards systematic method, the author follows De Toni in the main, and for Cyanophyceæ, Gomont, Bornet, and Flahault. He describes his methods of preparation and examination of the samples collected, and gives a list of literature.

Fresh-water Algæ of East Greenland.‖—E. Larsen has worked out the collections made by Kruuse and Hartz on the East Greenland Expedition, and by Kruuse in the Angmagsalik district. The author finds 125 Chlorophyceæ, of which 47 species are new to Greenland, and 1 Phæosporea. The fresh-water algæ of East Greenland number at the present time 188, of which 150 are Desmidiaceæ. Two new species and

* Bull. Torrey Bot. Club, xxxii. (1905) pp. 223–29 (2 pls.).
† Malpighia, xix. (1905) pp. 117–20
‡ Nuov. Notar xvi (1905) pp. 54–8.
§ Hedwigia, xliv (1905) pp. 230–40.
‖ Meddel. Grönland, xxx. (1904) pp. 77–110 (10 figs. in text).

two new forms are described, and certain of the more interesting species are figured in the text.

Fresh-water Algæ of the East Indies.*—E. Lemmermann has examined the collections of fresh-water algæ made by Dr. Volz at Sumatra, West Java, the Singapore Botanical Garden, the environs of Bangkok in Siam, and in the Sandwich Islands. Eight new species and varieties are described, and lists are given of the species found in the fifteen samples taken by Dr. Volz. The flora of the tropics is compared with that of Europe, and a list is given of the more widely distributed forms found in the collections.

Peroniella gloeophila.†—J. L. Serbinow has studied the structure and polymorphism of this fresh-water species. He collected it on a peat-bog in Finland, growing in the transparent sheaths of the Desmid *Hyalotheca mucosa*, as well as in the filaments of *Gymnozyga Brebissonii*. He finds that the form of the vegetative cells is of two kinds. On *Hyalotheca mucosa* it is provided with a very long, filamentous, solid stalk, the base of which is widened out to form a disc of attachment. On the filaments of *Gymnozyga*, which has no mucilaginous sheath, *Peroniella* has no stalk, or at the most a very short one. The structure of *P. gloeophila* consists of a fairly thin cell-membrane, with a nucleus and lamella-like chromatophores with no pyrenoids. The absence of pyrenoids is, in the opinion of the author, the result of the chromatophores being formed from several distinct portions or lamellæ. Crystals of calcium sulphate occur among the cell-contents. The author suggests that species of *Fulminaria*, described by Gobi, Lagerheim, and Atkinson, are merely reduced forms closely allied to *Peroniella*.

Plankton of Lake Laceno.‡—A. Trotter has made a study of the plankton of this lake in the Avellino district, S.S.E. of Bagnoli Irpino. Its area comprises about three square kilometres, and the depth is about a metre and a half, except in one part, where it varies from 4–15 m. A sample of benthon contained 24 species of diatoms, while the plankton contained 35 species of Myxophyceæ, Chlorophyceæ, and Bacillarieæ, and 2 species of Peridineæ. A few animals were also taken. Altogether the author considers that the lake is rich in forms, both qualitatively and quantitatively; and that the general character of the plankton may be described as that of stagnant water, heleoplankton.

A New Chlamydomonas.§—H. Bachmann publishes his second paper on botanical investigations of the Lake of Lucerne. Among the phytoplankton of that lake there occurs very plentifully *Anabæna flos aquæ* in ball-like masses. These are enclosed in a grey, felty substance composed of numerous Vorticellæ, and the *Anabæna* is very rarely seen without this covering. As a regular accompaniment of these two organisms, the author finds a species of *Chlamydomonas*, which he describes here. He has not succeeded in cultivating it, on account of

* Abh. Nat. Ver. Bremen, xviii. (1904) pp. 143–74 (1 pl.).
† Script. Bot. Hort. Univ. Petrop. xxiii. (1905) 18 pp., 1 pl.
‡ Nuov. Notar., xvi. (1905) pp. 39–53 (1 pl.)
§ Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 156–62 (1 pl.).

the speedy death of both *Vorticella* and *Anabæna*. *Chlamydomonas inhærens* grows in nests of four or more cells in the coils of *Anabæna*. The cells are ovate, 7–13 μ long and 3–12 μ broad, and they all lie with the pointed anterior ends turned towards each other. The posterior end contains a green, bell-shaped chromatophore, within which is a large pyrenoid. In the angle of the chromatophore lies the nucleus, and in the anterior end are two pulsatile vacuoles. Motile cells possess a distinct eye-spot. The author quotes Dill's and Chodat's synopsis of the species, points out wherein his species differs, and gives a diagnosis of it.

Chlamydomonas.* — J. L. Serbinow describes a new method of cultivating species of this genus, with the help of its symbiosis with Saprolegniaceæ and their accompanying bacteria. He pours spring water into a large Koch basin, adding water which contains *Chlamydomonas*. In this he places ants' eggs or meal-worms, which are infected with Saprolegniaceæ. After a time the culture of *Chlamydomonas* develops strongly, and lasts a considerable time.

The author describes in the same paper a new form of *Chlamydomonas stellata*, which is devoid of pyrenoids. He regards *C. reticulata* as representing merely a form, without pyrenoids, of another species of the genus.

Bisschop van Tuinen, K.—**Iets over de Diatomaceeen.** (Remarks on Diatomaceæ.) *Het Nederl. Zeewezen*, iv. (1905) pp. 65–8.

Börgesen, F.—**Om Faeröernes Algevegetation. Et Gensvar.** (On the algal vegetation of the Faeröes. A reply.) *Bot. Notiser. Lund*, 1905, pp. 25–6.

Borzi, A.—**Generi nuovi di Chroococcaceae.** (New genera of Chroococcaceæ.)
[The author establishes the two new genera *Planosphærula* with species *P. natans*, and *Baoularia* with species *B. cærulescens*. The former is allied to *Microcystis*, *Cœlosphærium*, and *Gomphosphæria*, and occurs in fresh water. The latter resembles *Dactylococcopsis*, and occurs on fronds of marine algæ in Sicily.] *Nuov. Notar.*, xvi. (1905) pp. 20–1.

Breemen, P. J. van.—**Plankton van Noordzee en Zuiderzee.** (Plankton of the North Sea and Zuiderzee.) *Akad. Proefschr. Univ. Amsterdam* (Leiden, 1905) 182 pp., 2 pls.

Brehm, V., & E. Zederbauer—**Das September-Plankton des Skutari-sees.** (The September plankton of the Scutari lake.) *Verh. k. k. Zool. Bot. Ges. Wien*, lv. (1905) pp. 47–53.

Bulletin des résultats acquis pendant les courses périodiques publié par le bureau du Conseil (permanent international pour l'exploration de la mer) avec l'assistance de M. Knudsen. (Bulletin of the results obtained during the periodic cruises, published by the office of the Permanent International Committee for the exploration of tho sea, with the assistance of M. Knudsen.) Sect. D., Plankton, Copenhagen, 1904–5.

Cushman, J. A.—**A few Ohio Desmids.**
[A list of 20 species collected from still water near Youngstown, Ohio. One new species is described, *Cosmarium Amesii*, and some of the other species are rare in America, and new to Ohio.] *Ohio Naturalist*, v. (1905) pp. 349–50.

* Bull. Jard. Imp. Bot. St. Petersburg, v. (1905) 13 pp., 2 pls.

DALLA TORRE, K. W. VON.—**Bericht über die Litteratur der biologischen Erforschung des Süsswassers in der Jahren 1901 und 1902.** (Report on the literature of biological investigation of fresh-water in the years 1901 and 1902.)
Forsch. Ber. Biol. Stat. Plön., xii. (1905) pp. 354–418.

EICHLER, B.—**Chromatophyton Rosanowii Woron.**
Wszechświat, 1904, pp. 524–5. (Polish.)

„ „ **Niezwykły gatunek oscylaryi.** (On a peculiar species of *Oscillaria*.)
Tom. cit., p. 668. (Polish.)

FITSCHEN, J.—**Das pflanzliche Plankton zweier nordhannoverschen Seen.** (Phytoplankton of two lakes in North Hanover.)
Aus der Heimat, für die Heimat. Jahrb. Ver. Naturk. a. d. Unterweser, 1904 (Bremerhaven, 1905), 21 pp.

FUCHS, TH.—**Kritische Besprechung einiger im Verlaufe der letzten Jahre erschienenen Arbeiten über Fucoiden.** (Criticism of certain works on Fucoideæ published during the last few years.)
Jahrb. Kais. Kgl. Geol. Reichsanst. liv. (1904) pp. 359–88.

GOROSCHANKIN, J. N.—**Beiträge zur Kenntnis der Morphologie und Systematik der Chlamydomonaden.** (Contributions to a knowledge of the morphology and systematic position of the Chlamydomonadæ.)
[Continuation, describing *Chlamydomonas coccifera*, a new species.]
Flora, xciv. (1905) pp. 420–3 (1 pl.).

HEERING, W. & H. HOMFELD.—**Die Algen des Eppendorfer moores bei Hamburg.** (The algæ of the Eppendorf Moor, near Hamburg.
Verh. Naturw. Ver. Hamburg, xii. (1904) pp. 77–97.

HY, F.—**Sur le Nitella confervacea Braun.**
Bull. Soc. Bot. France, lii. (1905) pp. 88–94.

KEISSLER, K. VON.—**Mittheilungen ueber das Plankton des Ossiacher-sees in Kärnten.** (Report on the Plankton of Lake Ossiach in Carinthia.)
[Concluding portion.] *Oesterr. Bot. Zeit.*, lv. (1905) pp. 189–92.

KULWIEC, K.—**Materyały do fizyografii jeziora Wigierskiep.** (Contributions to the physiography of the Wigry Lake.)
Pam. Fizyogr., xviii. (1904) pp. 2–42 (3 pls., 12 figs.).

LARTER, C. E.—**North Devon Cryptogams.**
[Five parasitic algæ, additional records for the county.]
Journ. Bot., xliii. (1905) p. 188.

LIVINGSTON, B. E.—**Notes on the Physiology of Stigeoclonium.**
[Gives an account of two series of experiments: (1) with low temperatures, (2) with sea-water. From the first series the author concludes that low temperatures act upon the vegetative growth of this alga with the same result as do high osmotic pressure and poison cations. As to the second, filaments placed in undiluted sea-water take the typical *Palmella* form, as in other solutions of high pressure. Zoospores are not produced, nor do those previously produced germinate.
Bot. Gazette, xxxix. (1905) pp. 297–300 (figs.).

LORENZI, A.—**Alcune notizie biologiche sul laghetto di Comino nelle Prealpi Carniche.** (Biological notes on the lake of Comino in the Carnic sub-Alps.)
In Alto., xv. (1904) 60 pp.

MARPMANN, G.—**Ueber die Präparation der Diatomeen, Foraminiferen, Polycystineen, und Spongillen.** (On the preparation of Diatoms, etc.)
Zeitsch. Angew. Mikrosk., x. (1904) p. 141.

„ „ **Ueber das Vorkommen und die Aufnahme des Siliciurus in den Kieselalgen und über einige Fort Schritte der Diatomaceenkunde.** (On the occurrence and absorption of silica in Diatoms, and on certain advances in the knowledge of the Diatomaceæ.) *Zeitschr. Angew. Mikrosk. Klin. Chemie*, xi. (1905) pp. 29–41.

Mayer, P.—Ueber die Verwendung des Planktonsuchers. (On the employment of the seeker for Plankton.) *Zeitsch. Wiss. Mikrosk.*, xxi. (1905) pp. 447–9.

Mazza, A.—Noticine algologiche. (Algological notes.)
[The author enumerates certain algæ found at Leghorn and at Naples, and discusses the question whether or not *Halurus equisetifolius* Kütz., has been found at Leghorn by Corinaldi. In an abstract of this paper in the *Centralblatt*, J. B. de Toni states that he has seen an authentic specimen of *H. equisetifolius* collected by J. Agardh at Leghorn in Herb. Treviranis Bot. Inst. at Genoa.] *Nuov. Notar.*, xvi. (1905) pp. 15–19.
Centralblatt, xcviii. (1905) p. 412.

Migula, W.—Characeæ Rossicæ ex herbario Horti Petropolitani. Russian Characeæ from Herb. St. Petersburg.) *Act. Hort. Petrop.*, xxiii. (1904) fasc. 3.

Mouti, R.—Physiobiologische Beobachtungen an den Alpenseen zwischen dem Vigezzo und dem Onsernonethal. (Physiobiological observations on the Alpine lakes between the Vigezzo and Onsernone valleys.)
Forsch. Ber. Biol. Stat. Plön., xii. (1905) pp. 63–89.

Murray, J.—Microscopic Life of St. Kilda. *Ann. Scot. Nat. Hist.*, 1905. pp. 94–6.

Nadson, G.—Ein apparat zum Erlangen von Grundproben aus Gewässern. (An apparatus for the obtaining of samples from the bottom of water.)
Bull. Jard. Bot. Imp. St. Petersburg, iv. (1905) pp. 170–1.

Nave, J.—Collector's Handbook of Algæ, Desmids, Fungi, Lichens, Mosses, etc.
[Instructions for their preparation and for formation of herbarium.]
London, 1905, 214 pp. (figs.).

Pampaloni, L.—Sul comportamento del Protococcus caldariorum Magnus in varie soluzioni minerali ed organiche. (On the behaviour of *P. caldariorum* Magnus in various mineral and organic solutions.)
[The result of various experiments in laboratory cultures, and a tabulated summary of the author's results on *P. caldariorum* compared with those of Grintzesco on *Scenedesmus acutus* Meyen, and *Chlorella vulgaris* Beyerinck.] *Annali di Bot.* ii. (1905) pp. 231–50 (1 pl.).

Riddle, L. C.—Brush Lake Algæ. *Ohio Naturalist*, v. (1905) pp. 268–9.

Ruttner, F.—Ueber das Verhalten des Oberflächenplanktons zu verschiedenen Tageszeiten im Grossen Plöner See und in zwei nordböhmischen Teichen. (On the state of the surface plankton at various times of day in the Great Plön Lake and in two ponds in N. Bohemia. *Forsch. Ber. Biol. Stat. Plön.*, xii. (1905) pp. 35–62 (1 pl. 2 tables, 1 text fig.).

Schmidle, W.—Algologische Notizen. (Algological notes.)
Alg. Bot. Zeitsch., xi. (1905) pp. 63–5.

Torka, V.—Während des Ausflugs am Aug. 14, 1904, bei Kramfliess und Promno in der Nake von Pudewitz beobachtete Moose und Algen. (Mosses and algæ observed during the excursion of Aug. 14, 1904, to Krammfliess and Promno in the neighbourhood of Pudewitz.) *Zeit. Naturw. Abt. Deutsch. Ges. Kunst u. Wiss. Posen*, xi. (1904).

Vogler, P.—Bisherige Resultate variationsstatistischer Untersuchungen an Planktondiatomaceen. (Results obtained hitherto by investigations on the statistics of variation in Plankton-diatoms.
Forsch. Ber. Biol. Stat. Plön. xii. (1905) pp. 90–101 (2 tabs., 8 figs.).

Wager, H.—The Present State of our Knowledge of the Cytology of the Cyanophyceæ. *Rep. Brit. Ass. Adv. Sci.* 1904 (1905) pp. 802–3.

Yendo, K.—On Coccophora Langsdorfii Grev.
[The author shows that *C. Langsdorfii* and *C. phyllamphora*, are one and the same plant, the former being a fertile, the latter a sterile specimen. He considers the genus to be most nearly related to *Sargassum*.]
Bot. Mag. Tokyo, xviii. (1904) pp. 237–41 (Japanese).

ZACHARIAS, O.—**Hydrobiologische und Fischereiwirthschaftliche Beobachtungen an einigen seen der Schweiz und Italiens.** (Observations on the hydrobiology and fishery economy of certain lakes in Switzerland and Italy.) *Forsch. Ber. Biol. Stat. Plön*, xii. (1905) pp. 169–302 (18 figs.).

" " **Ueber die systematische Durchforschung der Binnengewässer und ihre Beziehung zu den Aufgaben der allgemeinen Wissenschaft vom Leben.** (On the systematic investigation of inland waters and their relation to the problems of the general science of life.) *Tom. cit.*, pp. 1–34.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Chytridiaceæ.*—W. Loewenthal describes the species of a new genus *Zygorhizidium Willei*, which is a parasite of the alga *Cylindrocystis*. The main part of the fungus remains outside the host tissue into which penetrate short, delicate rhizoids. Besides the usual formation of sporangium and zoospores there is a sexual form of reproduction. Certain individuals—antheridia—form fertilisation tubes which grow towards the female cell, the latter having produced a small protuberance. Fusion takes place, and a zygote is formed. The later history of the zygote was not followed. If no fertilisation occurs the antheridium may become a zoosporangium.

Monoblepharideæ.†—M. Woronin left behind him a series of observations and researches on the genus *Monoblepharis*, which have since been published. He reviewed first the work done by others on the same subject, and then proceeded to describe more especially *M. sphærica*. The chief characteristic of this species is the hypogynous antheridium. He found that frequently the oospheres issue from the oogonium after fertilisation. The development of the antheridia and the process of fertilisation have been carefully followed. He observed that the oogonium was always closed until fertilisation, and that the spermatozoids pierced the oogonial papilla. The wall of the oospore is formed of two layers, and the warts on its surface arise from the inner sheath of the outer membrane.

Culture Experiments with Morchella.‡—Marin Molliard published some time ago the results of his culture experiments with the spores of *Morchella*. He at that time succeeded in producing sterile mycelium in pure cultures, and on adding certain organic substances to the medium the conidial form *Costantinella cristata* grew abundantly. He had noted that *Morchella* was often found in places where fruits such as apples and pears had been buried, so he planted the sterile mycelium in earth along with apples. In one case *Morchella* was produced; in another both *Morchella* and *Costantinella*. Molliard thinks these facts might be utilised in the culture of the Morel.

* Arch. für Protistenkunde, v. (1905) pp. 221–39 (2 pls.).
† Mem. Acad. Imp. Sci. St. Petersburg, ser. 8, xli., No. 4 (1904) 24 pp., 3 pls. See also Bot. Centralbl., xcviii. (1905) p. 587.
‡ Comptes Rendus, cxl. (1905) pp. 1146–8.

G. Fron * in another note reports on the same subject from a chemical point of view. His aim was to find out which were the organic substances most favourable to the growth of *Morchella*. He finds that the mycelium requires nourishment, largely of hydrocarbons and inulin, as well as glucose, and starch is peculiarly favourable to their development. The mineral constituents are less important, but it is necessary to furnish phosphates, nitrates, and salts of calcium in neutral or only slightly alkaline media.

Ch. Prepin † calls attention to his publication in the *Comptes Rendus* 1901, of results obtained in the culture of *Morchella*, exactly comparable with those now published by Marin Molliard. He got good growths of the fungus from a compost of apples and also from branches buried in a silo. He could not succeed in producing ascospores in pure cultures, and his opinion is that bacteria are necessary for their development. He has proved also that the nutrition of these fungi is afforded by some cellulose substance. In the case of the apples the sugar must disappear quickly, and only the cellulose of the pulp can be present to provide for prolonged growth of the fungus.

Fermentation with Mucor.‡—C. Wehmer has experimented with *Mucor* yeast, as to the effect of oxygen in hindering the fermentation process. He finds that this is not the case, and that exclusion of air is as unnecessary in the case of *Mucor* as in *Saccharomyces*. He gives an account of the experiments he carried out, the fungus being *Mucor racemosus*.

Stearophora radicicola.§—L. Mangin and P. Viala describe a fungus that they found again and again in the roots of vines that had been attacked by *Phylloxera* and other diseases. The mycelium of the fungus *Stearophora* penetrates into the tissues of the cortex and the wood. In the vessels it becomes massed into dark looking clumps or sclerotia. In artificial cultures sclerotia are also formed. Two organs of fructification were noted. On the artificial cultures, after much intricate growth, very fine hair-like filaments were produced, dark coloured like the rest of the mycelium, but the end cell was colourless, and the spores were produced inside the cell. They are extremely small, resembling minute bacteria. The second method of fructification also results in endospores produced in the larger hyphæ. A swelling takes place often at the insertion of a branch, and in the cell thus formed spores are produced similar to the others. The authors think that the fungus represents a group of primitive ascomycetes with dissociated asci.

Charrin and Le Pley have experimented on animals with this fungus, and find that it has interesting pathogenic properties. It causes pseudotumours and anæmia, and also induces the formation of nodosities and deformations of the bones with a diminution of water, lime and phosphoric acid. The extreme minuteness of the spores enables them to traverse the tissues and to spread in all directions.

* Comptes Rendus, cxl. (1905) pp. 1187–9.
† Tom. cit., pp. 1274–5.
‡ Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 122–5.
§ Comptes Rendus, cxl. (1905) pp. 1477–82.

Sclerotinia Crataegi.*—P. Magnus describes the entire development of this fungus, which in the *Monilia* stage attacks and mummifies the fruits of the hawthorn and also destroys the leaves. Sclerotia thus arising from the fruit were kept in suitable conditions, and the *Peziza* fruit was formed. On the same sclerotia there grew layers of conidiophores which bud off at the apex rows of small globose conidia. This is the microspore form that has been described for other *Sclerotiniæ*. The ascospores differ from others of the genus in the apiculate ends. A comparison is drawn between various *Sclerotinia* species as regards their life history and spore formation.

Cytological Researches on some Ascomycetes.†—René Maire, in a few words, states the present extent of our knowledge of nuclear fusion and nuclear division in the Ascomycetes, quoting the work of Dangeard, Harper, Barker, Guillermond, and others, and then proceeds to give the result of his own research on the subject. He is occupied chiefly with the behaviour of the nuclei in the ascus. He has worked over a number of species, *Galactinia succosa*, *Acetabula acetabulum*, *Pustularia vesiculosa*, and species of *Morchella*, *Rhytisma*, *Hypomyces*, and two Lichens, *Peltigera canina* and *Anaptychia ciliaris*. He finds that there are two processes of formation of the ascus: (1) by the "hook" formation, where the median cell of the hypha becomes the ascus; and (2) by the branching of a hypha with synkarions, the terminal cells of the branches becoming the asci. *Galactinia succosa* belongs to the latter type.

After fusion of the two nuclei in the ascus of *Galactinia*, the first nuclear division is "heterotypique," proved by the synapsis condition at the prophase stage, and because of the behaviour of the chromosomes, which divide during their ascent to the poles. The second division of the nucleus is "homotypique;" there are eight protochromosomes representing the half-chromosomes that were formed during the anaphase of the preceding division. The third division is "typique"—there are only four chromosomes formed in the early stage. He finds from his own work and that of others, that this number, however, varies in different species of Ascomycetes. He gives an account also of the formation of centrosomes and spindle which have an intranuclear origin; the polar irradiations first described by Harper have an extranuclear origin. He has also examined the secretions of latex in *Galactinia*; certain hyphæ are laticiferous, as in the Basidomycetes. In the ascus there is also a secretion of latex, which is not utilised by the nuclei, and is expelled along with the spores. There are in addition minute oil drops in the cytoplasm of the ascus, which gather round the nuclei and unite in the spore into two large guttæ.

Bi-nucleate Cells in Ascomycetes.‡—G. Massee finds bi-nucleate cells in the hypha and conidia of *Hypomyces perniciosum*, and that the two nuclei present in the conidium fuse at an early stage of development; on germination, the germ-tube is uninucleate. He gives other instances of binucleate cells in the Ascomycetes, and points out the

* Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 197-202 (1 pl.).
† Ann. Mycol., iii. (1905) pp. 123-54 (3 pls.).
‡ Ann. Bot., xix. (1905) pp. 325-6.

great variation to be found as to the number of nuclei in the cells of Ascomycetes and in other fungi in closely related forms.

Willow Canker.*—So long ago as 1899 specimens of diseased rods from the osier-beds in Connemara have been sent to Dublin for examination. T. Johnson, who has recently had opportunities of visiting the district and seeing the extent of the disease, now gives an account of its origin and spread, and the methods he considers best for destroying the fungus. The plants had been infested when they were first planted. The disease, due to a Pyrenomycete, *Physalospora gregaria* Sacc., appears as black specks or canker-spots on the rods, destroying the tissue and causing the rods to break at the damaged areas. Besides the ascosporous stage there are two other forms, which he calls *Tetradia salicicola* and *Macrodendrophoma salicicola*, both pycnidial stages of the fungus. All three forms propagate the disease. Formalin has proved a good fungicide. Burning of all diseased sets is recommended.

Specialisation of Parasitism in the Erysiphaceæ.†—E. S. Salmon has carried out a further series of experiments in connection with his study of biologic species of parasites. He has proved that the results of the inoculation experiments are the same, whether he works with ascospores or with the conidial forms. The recent experiments were made with the conidia of the biologic form of *Erysiphe graminis* on wheat. With these he successfully infected young leaves of *Hordeum silvaticum*, and kept the fungus growing through five generations; after that the conidia readily infected wheat, while their power of infecting their original host had not been weakened. Another discovery was that the successive generations had a weakened power of infecting *Hordeum silvaticum*. The spores seemed to lose vigour away from their normal host. Throughout this experiment only young leaves could be successfully infected.

Research on Yeast.‡—W. Henneberg has been experimenting with yeast cells to test life duration and the effect of foreign organisms in the cultures, etc. He concludes that the duration of vitality depends largely on the "race"; some races being specially long-lived. A somewhat low temperature is conducive to longevity; at 30° the cells persisted only a week, at 10° they lived for about four weeks, also on the surface of a large mass the cells persist longer than those deeper down. The readier access of oxygen would account for the difference. In all cases some few cells would be more vigorous and resistant than the bulk of the culture. Certain bacteria have a fatal effect, such as the bacteria of lactic acid and of acetic acid. Other bacteria are harmless.

Hyphomycetes.§—G. Lindau concludes in this fourth part the description of *Gliocladium* begun in the third part, p. 176. He then follows with the Botrytideæ, under which he includes all those forms

* Sci. Proc. Roy. Dublin Soc., x. (1904) pp. 153–66 (3 pls.).
† Ann. Mycol., iii. (1905) pp. 172–84.
‡ Wochensch. Brauerei, Nos. 41–8 (1904) 46 pp.; published 1905. See also Hedwigia, xcviii. (1905) p. 106.
§ Rabenhorst's Kryptogamen-Flora, I., Abt. viii. Pilze, Lief 95, Leipzig, 1905, pp. 177–256.

in which "the conidia are borne directly on the mycelium, or on conidiophores that are side branches of the mycelium, but have not yet produced specialised conidiophores." The division includes such genera as *Chætoconidium*, *Acremonium*, *Sporotrichum*, etc., down to *Botrytis*, *Cylindrophora*, *Cylindrodendrum*, *Sporodiniopsis*, and *Tolypomyria*. The different genera are well illustrated by figures in the text.

Agricultural Microbiology.*—Under this title J. Arthaud-Berthet gives the results of his study of the fungus, *Oidium lactis*. It is known as a frequent saprophyte of organic matter, and has been found to affect injuriously the production of cheese. The author worked with Pasteurised cream in which the fungus had been destroyed. The oidium, it is found, turns the cream rancid, though it is of service in the maturation of certain cheeses. Lactic ferments create lactic acid in the cheese, and the acid prevents the growth of moulds. The moulds, when they do succeed in growing, consume the lactic acid and produce an alkaline condition which encourages the growth of certain bacteria, and is otherwise detrimental to the cheese.

Uredineæ.†—P. and H. Sydow have issued the fifth fascicle of their work on Uredineæ, which completes the account of the genus *Puccinia*, and forms the final instalment of the first volume. They have written a preface to the volume and a short general account of the genus. They reject *Diorchidium* and *Uropyxis*, the characters given not being of generic importance. A sketch is given of the geographical distribution and of the economical importance of the Uredineæ. Indices of hosts and parasites are appended.

Klebahn ‡ records results of experiments on 30 different forms of Uredineæ. He draws special attention to the influence of *Cronartium ribicola* on *Pinus Strobus*, which causes the leaves attacked to revert to the early single form of seedling Pines.

Dry-rot.§—H. Duchaussoy describes the dry-rot fungus, *Merulius lachrymans*, and gives various instances of the damage it has caused in various localities; he describes also the effect produced by it on the wood that it attacks. He finds there is no certain method of detecting contaminated wood until the fungus has gone too far to save the substratum, but much can be done in the way of prevention. Good ventilation is very efficacious, and impregnating the wood with some form of creosote is a certain preservative.

Chemistry of Amanita muscarius.‖—W. Heinisch and J. Zellner tested the component substances of a large number of specimens of *A. muscarius*. The ash analysis gave a high percentage of potassium and phosphates, with a smaller amount of calcium. Chlorine was more

* Comptes Rendus, cxl. (1905) pp. 1475–7.
† Monographia Uredinearum, i., Fasc. v. (Borntraeger, Leipzig, 1904) pp. xxxv. and 769–972 (4 pls.).
‡ Zeitschr. Pflanzenkr., xv. (1905) pp. 65–108 (1 pl. and 4 figs.).
§ Bull. Soc. Linn. Nord de la France, xvi. (1902–3) pp. 175–81.
‖ Anz. Kais. Wissensch. Wien, ix. (1904) pp. 89–90. See also Bot. Centralbl., xcviii. (1905) p. 463.

abundant than in other fungi. Extracts with petroleum-ether gave fats very rich in palmitin and oleic acid.

Mycological Notes.*—C. G. Lloyd prints No. 18 of these papers, with photographic plates of the plants described. The genera *Trichaster*, *Lanopila*, *Lasiosphæra*, *Schizostoma*, *Broomeia*, *Battareopsis*, and *Gyrophragmium* are passed in review. The latter genus is, he considers, identical with *Polyplocium*, and is not a true gastromycete. Notes are added on various other subjects, on micro-photographs, an albino *Geaster*, a colourless form of *G. triplex*, etc. He has also issued recently "The Lycoperdaceae of Australia, New Zealand and neighbouring Islands,"† with illustrations of the type specimens he has found in the museums of Europe and elsewhere.

Effects of Copper on Fungi.‡—W. Ruhland has studied the question as to the exact effect of Bordeaux mixture when used as a spray on the leaves and on the fungal parasites. In the latter case he considers that the excretions of the hyphæ due to metabolism dissolve the copper and thus induce fatal poisoning. Experiments with spores of *Aspergillus niger*, *Botrytis vulgaris Cephalothecium*, *roseum*, and *Clasterosporium* gave similar results. In some cases washing the poisoned spores with a weak solution of hydrochloric acid restored their vitality.

Nomenclature of the Organs of Pyrenomycetes and Deuteromycetes.§—G. B. Traverso goes carefully through the different groups and genera of fungi in these two classes, explaining and exemplifying the terminology of the many forms to be found in the fruiting bodies and in the spores. He adopts the method of classification followed by Saccardo and by almost all mycologists, that of arranging the genera according to the type of spore. He gives an index of the Latin terms used in his paper.

Sylloge Fungorum.‖—P. A. Saccardo has brought his great work well up to date in this latest issue, which includes all recently published species from Hymenomycetes to Laboulbeniaceæ, 3225 species in all. There are 17 species described for the first time in this volume. A Bibliotheca mycologica by G. B. Traverso is added. There are also host or habitat, generic, and species indices. The volume containing Discomycetes and Deuteromycetes is promised early in 1906.

Physiological Anatomy of Fungus Galls.¶—H. Ritter von Guttenberg has studied the alteration of tissues or new growths induced by fungus parasites in the host plant. The fungi he examined were species of *Albugo*, *Exoascus*, *Ustilago*, *Puccinia*, and *Exobasidium*. He describes the galls formed by the fungi and the process by which the cells change their function or are destroyed altogether.

* Mycological Notes, No. 18, Cincinnati, Ohio, 1904, pp. 189–204 (7 pls. and 6 figs.).
† Lloyd Library, Cincinnati, Ohio, April, 1905 (15 pls. and 49 figs.).
‡ Arb. biol. Abt. Land. und Forstw. K. Gesundheitsamt, 1904, p. 157. See also Bot. Zeit., lxiii. (1905) pp. 139–41.
§ Nuovo Giorn. Bot. Ital., xii. (1905) pp. 261–80 (67 figs.).
‖ Sylloge Fungorum. Supplementum universale, xvii. part vi. (Patavii 1905) 991 pp.
¶ W. Engelmann (Leipzig, 1905) 70 pp., 4 pls.

Witches' Brooms of Quercus rubra and other Woody Plants.*—The case of Witches' Broom examined by H. Solereder represented small trees growing upright from a branch of the host. The origin of the growth could not be detected; no fungus mycelium was discovered in the tissues. The author gives a careful list of all recorded cases of similar growths with references to the literature of the subject. These abnormal growths are due in most cases to species of *Exoascus*, to Uredineæ, or to insects. In some cases, as the above, their origin has not been discovered.

The Fungus of Lolium temulentum.†—Anton Nestler has been examining *Lolium* plants, and finds the fungus in the fruits of *L. perenne* and *L. italicum*, as well as in that of *L. temulentum*. The infected fruits of the latter germinate more readily than in the two former cases. Culture experiments were made with the fungus on beerwort gelatin with *Lolium* extract. Only once was a hyphal growth observed, and it stopped very soon. Further cultures are desirable.

British Mycology.‡—The Transactions of the Mycological Society have just been issued under the editorship of Carleton Rae, the Hon. Sec. and Treasurer. He gives an account of the annual fungus foray in the autumn, and an account of the rarer species of fungi that were gathered. A complete list of these fungi is added.

C. B. Plowright contributes a sketch of Eriksson's Mycoplasma hypothesis. He withholds judgment until more is known of the matter, though he thinks such a theory might explain much that is obscure in the outbreaks of rust and potato diseases. He also publishes a description of a new *Peniophora* that has proved a very harmful disease of *Chrysanthemum*. It attacks the lower part of the stem. The disease was first noticed many years ago, and recently there has been a fresh development of the fungus.

Saccardo's rules of nomenclature have been translated by C. Rea, and commented on by the members of the society. R. H. Biffen contributes a paper on Parasitism. He describes the recent advances in our knowledge of the subject as regards biologic forms, bridging species, etc. The fungi new to Britain form the subject of a paper by A. Lorrain Smith and Carleton Rea. A large number have been added to the British flora during the year.

Mycology.§—Franz von Höhnel publishes a series of descriptions and corrections of fungi records. There are critical notes on classification and nomenclature, and descriptions of new genera and species. *Garcinodochium* g.n. found on decaying plants and on the ground is allied to *Dacryodochium* and *Lachnodochium*. *Dendrostilbella* g.n. is a *Stilbella* with branched sporophores; the spores are very small. This genus forms a transition between *Stilbella* and *Pirobasidium*. It is the

* Naturwiss. Zeitschr. Land. Forstw., iii. (1905) pp. 17–23. See also Bot. Centralbl., xcviii. (1905) pp. 464–5.

† SB. K. Akad. Wiss. Wien, cxiii., Abt. 1 (1904) pp. 530–46 (1 pl.). See also Hedwigia, xcviii. (1905) p. 109.

‡ Trans. Brit. Mycol. Soc., 1904 (Worcester, 1905) 100 pp. (4 col. pls.).

§ Oesterr. bot. Zeitschr., liv. (1904) pp. 425–39; lv. (1905) pp. 13–24, 51–5. See also Bot. Centralbl., xcviii. (1905) pp. 416–17.

conidial form of a *Coryne*. The author cites a number of genera and species that are identical with others previously described.

Sowerby's Drawings of Fungi.*—Worthington G. Smith takes occasion to publish various notes that he has made in looking over these plates, which clear up various puzzling remarks of Sowerby's. These unpublished remarks answer many of Fries's queries. In one instance descriptions of two important plates had been transposed. In others, notes by Sowerby had been added after printing. W. G. Smith describes under each fungus the changes that have been made, and adds any information bearing on the drawings.

Fungal Parasites of Insects.†—Casimir Wize gives an account of a number of fungi that are economically of great importance, as they live on the larvæ of insects that destroy turnips, etc. *Cleonus punctiventris* is one of these destructive larvæ, and it is attacked most virulently by *Oospora destructor*, a white mould, which often destroys 100 per cent. of the larvæ. *Sorosporella uvella* and *Massospora Cleoni*, two closely allied fungi, are only a little less effective. Species of *Isaria*, *Botrytis*, *Acremonium* and *Strumella* have also been found preying on the insects. *Gymnoascus umbrinus*, which was found on larvæ, seems to be parasitic on the *Isaria* that destroyed the larva. Wize describes a new form of Chytridineæ, *Olpidiopsis ucrainica*, which he discovered in the larvæ of *Cleonus* and in the pupa of *Anisoplia austriaca*. He gives detailed accounts of all these fungi, and of their action on the insects.

Myxobacteriæ.‡—E. Zederbauer revises Thaxter's work on the Myxobacteriæ, and reports observations and culture experiments he himself has made on these organisms. He finds that they are a simple order of bacteria, but that they are symbiotic, and the bodies described by Thaxter are composed of both fungi and bacteria, as Lichens are composed of fungi and algæ. He has succeeded in two cases, *Myxococcus incrustans* and *Chondromyces glomeratus*, in separating the component plants and growing them independently. The spores of *Myxococcus* developed hyphal filaments which produced conidia. The bacterium also developed on gelatin and agar-agar, and produced characteristic spores. The same results were obtained in the cultures of *Chondromyces*. Zederbauer proposes to call the group bacterio-lichens (*Spaltpilzflechten*). The cysts are composed of both fungus and bacterium. This is, he considers, a case of symbiosis, as both the organisms are healthy and capable of separate development. Probably the fungus gains some advantage by living on the mucilage of the bacterium, or the bacterium again is nourished by substances excreted by the fungus. The separate species developed are described in detail, the symbionts of *Myxococcus* as *Torula*, and the *Bacterium* as *Myxococci incrustantes*.

Notes on Mycetozoa.§—A. and G. Lister publish a series of notes on species already recorded. They discuss the supposed relationship

* Journ. Bot., xliii. (1905) pp. 156–60.
† Bull. Inter. Acad. Sci. Cracovie, No. 10, 1904, pp. 713–27 (1 pl. and 11 figs.).
‡ SB. Akad. Wiss. Wien, cxii. (1903) pp. 447–82 (1 pl.).
§ Journ. Bot., xliii. (1905) pp. 150–6.

between *Chondrioderma ochraceum* and *Lepidoderma tigrinum*. The two are not identical, though in some respects very near akin to each other. A large gathering of *Chondrioderma lucidum* is noted, the capillitium of which is constant in what was supposed to be an abnormal development. *Badhamia populina* was again discovered two years after the date of the first gathering, on both occasions in Wanstead Park. A third gathering of the species has been made in France. New localities are given for other rare species. A note is added on Bedfordshire Mycetozoa. Straw heaps had been found there to be exceptionally suitable feeding-ground. Many new species have been discovered, and the records of growth kept from year to year. The forms appear one year in more or less abundance and disappear another.

BOUDIER.—**Icones Mycologicæ. Série 1, Livraisons 2, 3.** (Published drawings with explanations of the plates. Two new species are described.)
Klincksieck, Paris, 1904. See also *Bot. Centralbl.* xcviii. (1905) pp. 494–5.

CITRON, J.—**Verhalten der Favus und Trichophyten-Pilze im Organismus.** (Behaviour of Favus and Trichophyte fungi in the organism.)
Zeitschr. Hyg., xlix. (1905) p. 120.
See also *Bot. Centralbl.*, xcviii. (1905) p. 517.

DIETTRICH-KALKHOFF, EMIL.—**Beiträge zur Pilzflora Tirols.** (Contribution to the Fungus Flora of the Tyrol.)
[Many of the species have been determined by J. Bresadola.]
Verh. K. K. Zool.-Bot. Ges., lv. (1905) pp. 203–11.

ELENEW, PAULUS.—**Enumeratio fungorum in provincia Smolenskiensi æstatibus 1897 et 1899 annorum collectorum.** (List of fungi collected in the province of Smolensk.). *Ann. Inst. Agron. Moscou*, x., livr. 3 (1904) pp. 507–44 (Russian).
See also *Bot. Centralbl.* xcviii. (1905) pp. 517–18.

GABOTTO, L.—**Contribuzione alla Floræ Micologica Pedemontana.** (Contribution to the mycological flora of Piedmont.)
[The list comprises 130 species.] *Nuovo Giorn. Bot. Ital.*, xii. (1905) pp. 53–77.

HOLLAND, J. N.—**Economic Fungi.**
[Lists of edible fungi with notes on some of the species.]
Naturalist, 1905, pp. 93–6, 121–5.

HENNINGS, P.—**Fungi Japonici. V.**
[A continuation of lists already published; several new species of microfungi are described.]
Engler's Bot. Jahrb., xxxiv. (1905) pp. 593–606.
See also *Hedwigia*, xcviii. (1905) p. 106.

„ „ **Zwei neue Cudonieen aus der Umgebung Berlins.** (Two new Cudonieæ from near Berlin.)
Abhandl. Bot. Ver. Prov. Brandenb., xlvi. (1904), pp. 115–19 (2 figs.). See also *Hedwigia*, xcviii. (1905), p. 107.

„ „ **Phaeosporella Marchantiæ P. Henn. sp. n.**
[The fungus was growing on dead thallus of *Marchantia*, and was associated with a pycnidial stage very like *Phyllosticta Marchantiæ*. *Tom. cit.*, pp. 120–1.
See also *Hedwigia*, xcviii. (1905) p. 107.

HÖHNEL, FRANZ V.—**Mycologische Fragmente, lxxvi.**
[The paper deals with the synonymy of various fungi.]
Ann. Mycol., iii. (1905) pp. 187–90.

HONE, D. S.—**Minnesota Helvellineæ.**
[Full description of the different species occurring in Minnesota.]
Minn. Bot. Studies, ser. iii., part 3 (1904) pp. 309–21 (3 pls.).
See also *Ann. Mycol.*, iii. (1905) p. 198.

LINDROTH, J. I.—**Mycologische Mitteilungen 11-15.** (Mycological contributions.)
[Notes on known species, and descriptions of new forms.
Acta Soc. pro Fauna et Flora Fenn., xxvi. (1904) 18 pp. (7 figs.).
See also *Ann. Mycol.*, iii. (1905) p. 198.

MURRILL, W. A.—**Terms Applied to the Surface and Surface Appendages of Fungi.**
[A glossary of botanical terms, more especially in their reference to fungi.]
Torreya, v. (1905) pp. 60-6.

REHM—**Psilopezia Berk. (Peltidium Kalchbr.) eine in Wasser lebende Discomyceten Gattung.** (*Psilopezia* syn. *Peltidium*, a water-inhabiting Discomycete.)
[Discussion of the different species of the genus, not all growing under water.] *Mitteil. No. 34, Bayer. Bot. Ges. Erforsch. heim. Flora*, 1905, pp. 424-5. See also *Hedwigia*, xcviii. (1905) p. 110.

RICK, J.—**Fungi austro-americani exsiccati. Fasc. i. Nos. 1-20; Fasc. ii. Nos. 20-40.**
[The list includes Basidiomycetes and Ascomycetes. There are a number of new species.] Berlin, 1905.
See also *Bot. Centralbl.*, xcviii. (1905) p. 586.

ROSTRUP, E.—**Fungi Groenlandiae orientalis in expeditionibus G. Amdrup, 1898-1902, a G. Amdrup, N. Hartz, et C. Kruuse collecti.** (Fungi from Eastern Greenland.)
[Some 90 species are recorded; 3 of these are new.]
Medd. om Grönland, xxx. (Copenhagen) 1904, pp. 113-21.
See also *Bot. Centralbl.*, xcviii. (1905) p. 548.

" " **Mykologiske Meddelelser, ix. Spredt. Iagttagelser fra 1899-1903.** (Mycological contributions, ix., scattered observations from 1899-1903.)
[A number of new species are described.]
Bot. Tidsskr., xxvi. Heft 3 (Copenhagen) 1905, pp. 305-17. (Résumé in French.)
See also *Bot. Centralbl.*, xcviii. (1905) pp. 548-9.

" " **Norske Ascomyceter.** (Norwegian Ascomycetes.)
Vidensk-Selsk. Skrift I. Math. Naturw. Kl., 1904. No. 4.
See also *Zeitschr. Pflanzenkr.* xv. (1905) p. 115.

SACCARDO, P. A.—**Le reliquie dell'erbario micologico di P. A. Micheli.** (Mycological herbarium of P. A. Micheli.)
[The author has published a revised list of fungi found among the papers of Micheli.] *Bull. Soc. Bot. Ital.*, No. 5 (1904).
See also *Bot. Centralbl.*, xcviii. (1905) p. 464.

SACCARDO, P. A. e G. B. TRAVERSO.—**Micromiceti italiani nuovi e interessanti.** (New or interesting Italian Micromycetes.)
[Diagnoses of new species, and observations on species already known.]
Tom. cit., pp. 207-21 (1 fig.).
See also *Bot. Centralbl.*, xcviii. (1905) p. 440.

SCALIA, G.—**Micromycetes aliquot siculi novi.** (Some new Micromycetes.)
[A number of new species are described.]
Rend. del Congress. Nazion. di Palermo, 1903, pp. 177-88.
See also *Bot. Centralbl.*, xcviii. (1905) p. 440.

SYDOW, H. & P.—**Novae Fungorum species ii.** (Diagnoses of eight new species of fungi.) *Ann. Mycol.*, iii. (1905) pp. 185-6.

TUBEUF, VON.—**Infectionsversuche mit Uridineen.** (Infection experiments with Uredineae.)
[Experiments were made with *Caeoma* spores on species of *Salix*, and with the spores of *Aecidium strobilinum* on *Prunus Padus*.]
Naturw. Zeitsch. Land und Forstw., iii. (1905), pp. 42-6 (8 figs.).
See also *Bot. Centralbl.*, xcviii. (1905) p. 466.

ULE, E.—**Mycotheca Brasiliensis. Cent. 1. Fungi exsiccati praecipue in regione fluminis Amazonici et nonnulli apud urbem Rio de Janeiro in annis 1899-1903 collecti.** (Fungus exiccata, chiefly from the region of the river Amazon and from near the town of Rio de Janeiro, collected during the years 1899-1903.)
Berlin, 1905. See also *Bot. Centralbl.*, xcviii. (1905) p. 549.

Lichens.

(By A. Lorrain Smith, F.L.S.)

Multi-nucleate Condition of Lichen Spores.*—In the genera *Pertusaria*, *Mycoblastus* and *Ochrolechia*, the ascus spores are very large, and in some of the species there is only one spore in the ascus. It seemed probable that such spores would be multi-nucleate, and W. Zopf has proved this by suitable fixation and staining of fresh material. The nuclei lie at equal distances from each other, and are connected by fine strands. Zopf calculated that in the spore of *Mycoblastus sanguinarius* there were 300–400 nuclei. Tulasne and De Bary have already found that these spores germinated by a large number of pores and with very fine germ-tubes. Such tubes would allow passage into them of the small nuclei of the spore.

Lichenological Notes.†—Max Britzelmayer publishes a list of Lichens collected in the Bavarian Alps, with notes as to their habitat. He deprecates the splitting of species where the difference is only slight. Under *Cladonia* he gives examples of alterations in the plant induced by change of environment. *Cl. gracilis* in the shade of the woods is whitish, in sunlight it becomes brown or olive-coloured, in addition to differences of form. He describes various forms of *Cl. rangiformis* and the varieties of *Lecidella goniophila* to the number of twenty.

Studies of Usnea.‡—Alceste Arcangeli gives an historical sketch of *Usnea sulphurea* with its geographical distribution. He then describes the structure and anatomy of the plant and its colour, the gonidia and the reactions to various chemicals. He is inclined to unite with this species the genus *Neuropogon*.

In another paper § he describes *Usnea articulata*, and criticises the results arrived at by Jatta in his study of this species. He does not look on the thallus as peculiar in the development of the central cylinder; he considers it to be only a variety of *U. barbata*.

Britzelmayer, M.—**Lichenes exsiccati floræ Augsburgensis. Supplementum i. et ii.** (Lichen exsiocata of the Augsburg Flora.)
[The numbers published are from 421 to 520.]
Berlin: R. Friedlander & Sohn, 1904.
See also *Bot. Centralbl.*, xcviii. (1905) pp. 420–1.

Zahlbruckner, A.—**Vorarbeiten zu einer Flechtenflora Dalmatiens.**
[The list includes diagnosis of several new species, with a critical review of Dalmatian species published by Körber in 1867.)
Oester. Bot. Zeitschr. lv. (1905) pp. 1–6 and 55–69 (1 pl.).

* Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 121–2.
† Hedwigia, xliv. (1905) pp. 199–217.
‡ Atti Soc. Tosc. Sci. Nat. Memorie, xx. (1904) pp. 152–66 (1 pl.). See also Bot. Centralbl., xcviii. (1905) p. 496.
§ Proc. Verb. Soc. Tosc. Sci. Nat., xiv. (1904) No. 2, pp. 46–52. See also Bot. Centralbl., xcviii. (1905) p. 466.

ZAHLBRUCKNER, A.—Kryptogamae exsiccatae editae a Museo Palatino Vindobonensi. Cent. x.–xi. (Cryptogamic exsiccata issued from the Vienna Museum.)
[Cent. x. is entirely fungi, and mostly microfungi. Decades 25–8 of Cent. xi. include Lichens. The plants are both European and extra-European.]
Ann. K. K. Nat. Hofmus. Wien Bd., xix. (1904) pp. 379–427.
See also *Bot. Centralbl.*, xcviii. (1905) pp. 334–7.

" " Lichenes Oranenses Hochreutineriani. (Lichens collected by Hochreutiner in Oran.)
[The lichen flora resembles that of Algiers. Two new forms are described.]
Ann. Conserv. Jard. Bot. Genève, vii.–viii. (1903–4) pp. 244–7.
See also *Bot. Centralbl.*, xcviii. (1905) p. 466.

" " Lichenes a cl. Damazio in montibus serra do Ouro Preto Brasiliae lecti in herb. Barbey-Boissier asservati. (Lichens collected by Damazio in Brazil and preserved in the Barbey-Boissier herbarium.)
[27 Lichens are recorded. Two varieties are new.]
Bull. Herb. Boiss., 2nd series, iv. (1905) pp. 134–6.
See also *Bot. Centralbl.*, xcviii. (1905), p. 467.

Schizophyta.

Schizomycetes.

Bacterial Origin of Macrozamia Gum.*—R. Greig Smith found in a film preparation made from a transparent colourless and gelatinous gum exuding from the fruit of the *Macrozamia Spiralis*, a short rod-shaped bacillus. A portion of the stalk attached to the fruit was cut off and incubated in glucose-gelatin for two days at 30° C. The molten medium was then smeared over plates of lævulose-asparagin-tannin-agar, and from the slime that formed an organism was isolated. A gum prepared from the slime was tested and compared with the natural gum; at first these did not entirely agree, but after an interval of six months, during which the organism was under cultivation in the laboratory, it was found that the gums both gave upon hydrolysis the same sugar-like body, and the author, considering that this was a most important indication of their identity, has no doubt that the bacillus was the producer of the gum exuded from the fruit. He named the organism the *Bacillus macrozamiæ*. It exists as short rods or cocco-bacteria, that vary in length from 0·9 μ to 2·2 μ, and in breadth from 0·4 μ to 0·8 μ; they are motile, and possess numerous peritrichous flagella, and do not stain by Gram. It forms slime at ordinary temperature; it does not grow under anaerobic conditions; on glusose-gelatin plates it forms white, glistening, moist, nipple-shaped colonies, and there is no liquefaction of the medium; in gelatin stab there is a rough white growth in the track, and gas bubbles are formed in the medium; on saccharose potato agar a raised white slime is produced, and the medium is cleft in all directions from the formation of gas; in broth the medium is rendered turbid, and carries floating broken films; indol reaction is obtained, and

* Proc. Linn. Soc. New South Wales, xxix. (1904) p. 863.

nitrates are reduced to nitrites; milk becomes strongly acid, and "appears to thicken."

Researches on the Bacteria found in the Intestine of the Larva of Mosca Olearia.*—L. Petri describes the characters of an organism isolated from the proventricular cæci of this larva. Cultures were made from dilutions of the contents of the cæci, and grown aerobically on ordinary media; all cultures grown under anaerobic conditions remained sterile. The colonies obtained on peptonised agar at 30° C. have a circular contour, increasing from 1 mm. to a very great diameter; they are of a yellow ochre colour; they have a central conglomerate portion, consisting of capsulated elements and alternating rings of freely motile bacteria and capsulated elements. Growth on gelatin is very slow, and the medium is liquefied. The yellow colonies are composed of very short cocco-bacilli, which attain a greater length on media containing large quantities of fatty matter, and in the intestine of the larva. The motile forms show five long peritrichous flagella; the yellow pigment is not soluble. From its possessing a voluminous capsule enclosing often great numbers of bacilli and resembling a true *Zooglœa*, he assigns this organism to the group of capsulated bacteria described by Babes as the genus *Ascobacterium*. The bacillus is common in moist soils, and is constantly found in the soil of the olive, and has been isolated from the cortex of the same olive plant, and at the end of the larval period, from the channels excavated by the larva; the larvæ, 1½ mm. long, have their four cæci completely full of these bacilli, and it is noteworthy that this accumulation of bacilli constitutes a tenth of the entire volume of the larva.

The resistance of the bacillus to acids is very weak; a 0·01 p.c. solution of tartaric acid is sufficient to arrest or impede its development; its resistance to fatty acids is much greater. It produces oxalic acid by its oxidising action on hydrocarbons; nitrates are not reduced; it does not form indol; it secretes a proteolytic enzyme that dissolves gelatin and peptonises milk; during its capsulated state it produces a substance of mucilaginous consistence that has the properties of pectin. From experiments made to ascertain the nature of its action on olive oil, it is suggested that the lipolytic action of the bacillus is effected by an ecto-enzyme poured out into the fluid culture, since, if this latter is filtered and placed in contact with a monobutterine, it shows a very energetic lipolytic action. The abundant secretion by this organism of a lipase, and its localisation in the intestine of the larva, whose nourishment is composed chiefly of fatty substance, makes it probable that between the larva and the bacterium there exists a symbiotic relationship.

Micro-organism showing Rosette Formation.†—Mabel Jones describes a spirillum-like organism isolated from water and sewage. Twenty-four hours' old cultures on agar consist of short, plump commas $1 \cdot 5\,\mu - 3\,\mu$ long, and $0 \cdot 5\,\mu - 0 \cdot 7\,\mu$ broad, with pointed ends, and arranged as spiral filaments, sigmas and rosettes, which last are in no way an agglutination phenomenon; the single polar flagellum of each

* Atti Reale Accad. Lincei, xiv. (1905) p. 399.
† Centralbl. Bakt., 2te Abt., xiv. (1905) p. 459.

organism is pointed towards an unseen centre, and the flagella take ordinary stains readily; rosette formation is favoured by culture on glucose agar under anaerobic conditions. The unattached organism is actively motile, the flagellum varying in length from two to five times that of the single cell; the rosettes are non-motile. The organism is reproduced by transverse division; spore formation was never observed; it does not stain by Gram; growth on gelatin shows creamy white to yellow colonies, and there is slow late liquefaction of the medium; in a gelatin stab, a third of the medium is liquefied after a month; grown in glucose agar, it formed no gas, but the flagella were much elongated; litmus lactose agar is decolorised after 2 weeks, but no alteration occurs in neutral red agar; on blood serum at 37° C. there is formed a delicate glistening, slightly opaque line, and occasionally distinct round colonies 3 mm. in diameter; no liquefaction of the medium occurs; on potato it forms moist patches, and shows many involution forms, but no rosette formation; broth cultures are uniformly clouded after 24 hours at 37° C., and show a blue-white pellicle clinging to the walls of the tube; hanging drops show abundant rosette formation: litmus milk is decolorised after 3 weeks, and after 44 days it becomes intensely alkaline and very viscid; indol formation was not observed; no fermentation takes place when grown in dextrose, saccharose, or lactose; it is a potential anaerobe, but growth is slower and less abundant in the absence of oxygen; its optimum temperature is 37° C.; it is killed by moist heat at 55° C. for 10 minutes; experiments to test its pathogenicity on guinea-pigs and pigeons were negative.

Bacterial Niveau of Beijerinck.*—K. B. Lehman and H. Curchod have studied the formation of these niveaus in *B. typhi*, *B. coli*, *Vibrio cholera*, *B. pyocyaneus*, and others. The term "niveau" is applied only to a collection of bacteria stretching as a horizontal skin across the fluid of the tube; besides the niveau they also distinguish the diffuse cloudiness of more or less compact collections of bacteria that are formed either above or below the niveau; between the niveau and the cloudiness there is a more or less well developed clear zone. They employed the following method:—5 c.cm. of ordinary nutrient gelatin was poured into a sterile tube, and, after solidifying, this was inoculated with a pure culture of an organism and covered with 16 c.cm. of sterile distilled water, so that the surface of the water stood at the height of about 8 cm.; the tubes were placed (upright) at room temperature and guarded against shaking.

With *B. typhi*, *B. coli* and *B. putidus* the niveau is well developed after 24 hours, and above it is seen a strong cloudiness ½ cm. high which is not separated from the niveau by any clear zone, and which disappears after 2–3 days; below the niveau, especially with *B. typhi* and *B. coli*, there is a thick cloudiness; with *Vibrio cholera* there is a cloudiness above and below the niveau, but the niveau lasts at most only 18 days.

With *B. pyocyaneus* there is at first a thin niveau with an underlying cloudiness and no intermediate clear zone, but after the seventh day, when the niveau has risen to its highest point and has begun to sink, a cloudiness commences to form above the niveau.

* Centralbl. Bakt., 2te Abt. xiv. (1905) p. 449.

With *B. fluorescens* a distinct cloudiness is present under the niveau, which is separated by a sharp clear zone; there is also a cloudiness above the niveau, but this is feeble after 30 days.

With *B. subtilis* there is formed at first a niveau with a very slight underlying cloudiness, the clear zone not being well marked; the niveau soon disappears, and flocculi, consisting of sporulating threads, appear in the fluid.

The authors never observed double niveaus. They found, as Beijerinck had seen, that the niveaus develop first in the lower strata in the neighbourhood of the nutrient material and then rise slowly, but that after 9–12 days they begin to sink again. Sharp niveaus are seen to form only with motile varieties. The niveaus appear where the amount of underlying nutriment and overlying oxygen form an optimum for the bacterial development. By pipetting off samples at different levels and making plates, they showed that the number of bacilli were much greater in the niveau than in the cloudiness above or below; thus in the case of *B. typhi* the average for three observations showed 2 colonies from the upper cloudiness, 48 colonies from the niveau, and 23 from the underlying cloudiness; and for *B. coli* 2, 100, and 57 respectively.

Comparative Study of Sixty-six Varieties of Gas-producing Bacteria found in Milk.*—F. C. Harrison finds that the gas-producing bacteria of milk belong to a large group of organisms, consisting of varying sized rods with rounded ends, that stain unevenly and are decolorised by Gram; they grow well on ordinary media at room temperature, better at 37° C.; they do not liquefy gelatin; they produce acid in milk, which is usually coagulated; they are potential anaerobes, reduce nitrates and ferment lactose, glucose, and other saccharoses. Several are typical *B. coli* and *B. lactis* aerogenes, and between these extremes there are manifold varieties. The author attempts to classify these into seven groups. He found that the neutral red test was of no value in separating the members of the *coli* group, and the agglutination test was only of limited value in diagnosing closely related varieties of *B. coli* and *B. lactis* aerogenes. The percentage of gas-producing forms to the total bacterial content of milks varied from a fraction of 1 p.c. to 34·3 p.c.; the organisms probably came from manure, flies, and in some cases from the udder of the cow. Gas-producing bacteria tainted cheese, and the coloured cheeses gave the appearance known as "mottled," which is probably the result of the bleaching action of the gases generated.

Bacillus Involutus.†—L. Waelsch describes the bacterial aspects of an organism obtained from non-venereal preputial secretion. On glycerin-agar and gelatin-agar plates inoculated with smegma, there appeared after 24 hours shining dew-drop colonies the size of millet seeds; these were round, sharply contoured with toothed margins, and contained strongly refractile granules, which were seen to consist of short rods lying in various directions. The rods were of various sizes and shapes, with rounded ends, and showed extraordinary involution forms; they

* Centralbl. Bakt., 2te Abt. xiv. (1905) pp. 349 and 472.

† Centralbl. Bakt., 1te Abt., xxxviii. (1905) p. 645.

stained by Gram, but at times they ended in long threads which were decolorised by this method; with Loeffler's methylen-blue the body of the organism was only faintly stained, but showed the presence of dark blue granules. On gelatin plates after two days there appeared minute, coarsely granular colonies with finely toothed margins, which by the fifth day showed yellow-brown centres, and later developed into flowery rosettes with black-brown centres; the gelatin is not liquefied. On glycerin-agar slope there appeared a dirty yellowish-white streak with a finely toothed margin which became more marked in older growths; in the water of condensation were yellow-white soft thread-like masses. There was similar growth on glucose agar with no formation of gas. On human blood serum-agar there was very rapid growth, the entire surface of the medium after 48 hours being covered by a grey-white shining membrane, consisting of coccal forms, short threads and stout bacilli, also many long rods and spindles. Broth cultures after five days showed uniform cloudiness and a thread-like deposit, but no pellicle formation; the culture consisted chiefly of threads, but there were also many involution forms. There was good growth on litmus milk which remained neutral and uncoagulated, and consisted chiefly of mono-, diplo-, and short streptococcal forms. On potato there was a slow and scanty growth, only with difficulty to be differentiated from the medium. The organism was not pathogenic for rabbits, guinea-pigs, rats, or white mice.

Micro-organisms of Meat Poisoning.*—H. de R. Morgan records his observations on these organisms. He gives details of the cultural reactions of 41 different strains of intestinal and food-poisoning bacilli. He found that culturally and biologically the bacilli of the enteriditis group and of the paratyphoid group include most of the organisms that give rise to food poisoning, and to cases of disease resembling typhoid fever. To determine whether the bacilli of these two groups were represented by analogous types in the intestines of normal animals, he examined fæces obtained from guinea-pigs, rabbits, sheep and pigs, and scrapings from the mucous surfaces of the small and large intestines of three pigs, three sheep, two bullocks, one horse, one calf, and one child dead from broncho-pneumonia. Emulsions from each in distilled water were made, and ½ c.cm. added to tubes of bile salt dulcit broth coloured with neutral red, and incubated at 42° C. for 24 hours. Of these cultures 4 c.cm. were injected subcutaneously into a number of guinea-pigs; from the heart blood of these animals, that died within four days, cultures were made on bile salt dulcit broth and incubated at 42° C. for 24 hours; if gas and acid were produced then neutral red bile salt agar plates were made and incubated at 42° C. for 24 hours; from the colourless colonies bile salt dulcit broth tubes were inoculated and incubated at 42° C. for 24 hours, and those tubes that gave gas and acid were used to inoculate broths containing glucose, dulcite, mannite, lactose, cane-sugar and pepton, also tubes of litmus milk, agar and gelatin. By this process he isolated 21 cultures of the enteriditis type, namely, motor rods like *B. enteriditis* of Gaertner, not staining by Gram, showing cream-coloured growth on agar and gelatin,

* Brit. Med. Journ., 1905, i. p. 1257.

which latter is not liquefied, giving acid and gas on glucose, dulcite and mannite broths, not affecting lactose or cane-sugar broths, rendering litmus milk at first acid and later alkaline, but producing no clotting. He also obtained 10 cultures of the paratyphoid A type, which agreed culturally with those of the other group, excepting that the litmus milk remained acid without clotting, and indol was produced at the end of five days. The scrapings from the intestines yielded a larger number of positive results than the fæces, owing to the fact that the bacilli are parasitic on the mucous surface of the intestine. As regards pathogenicity, the cultures of the *B. enteriditis* type were uniformly fatal in a few hours, whereas those of the paratyphoid A group were much less virulent, 25 p.c. of the inoculated guinea-pigs recovering. The presence of a toxin in the enteriditis cultures was demonstrated by injecting filtered broth cultures intraperitoneally, the animals dying within 24 hours.

He repeated his experiments, but made direct cultivations from the scrapings of the intestines without previously passing them through guinea-pigs; in this series out of 38 colonies 25 were of the paratyphoid A group and none of the *B. enteriditis* type, showing that these latter are really much less common in the normal intestine of animals than those of the other type, and that their apparently greater frequency in the first series of experiments was due to their greater virulence.

He gives details of his agglutination experiments, and concludes that in this respect the organisms fall into three groups, namely, (1) *B. enteriditis* Aertryche, or hog cholera type, (2) *B. enteriditis, psittacosis* type, (3) *B. paratyphoid* A, unknown type, not agreeing with either the bacillus of Schott Müller or that of Brion and Kayser.

New Microbe of Pulmonary Phthisis.*—v. Schreen finds that tuberculosis and phthisis are two different processes resulting from two organisms that differ in structural and biological characters. The microbe of phthisis is a branched sporulating thread, which under 185 magnifications appears about 1 mm. thick. At first the soft threads penetrate the alveolar epithelial cells, then throwing out lateral buds they form a fine network; the cell protoplasm is drawn up by the organism, and the atrophic nucleus, deprived of its chromatin, appears suspended in the centre of the transparent mesh. Neighbouring mycelia unite to form a tangled mass. The threads are hollow and without septa; on the end branches there appear small capsules, which at first are homogeneous, but later have a cavity with granular contents, which in the mature state are transformed into bundles of branched threads, which, leaving the capsule, attack the epithelial cells of the nearest alveolus. The author considers that this microbe does not form true spores, and that it is not to be classed with the Hyphomycetes. He did not obtain it in pure culture, and he gives no details of his methods of staining.

Tuberculosis and Pseudo-tuberculosis.†—F. Sanfelice has isolated from the air a number of cultures of Streptotricheæ, and has examined

* Centralbl. Bakt., 1te Abt. Ref., xxxvi. (1905) p. 561.
† Tom. cit., p. 572.

them as to their morphology, pathogenicity, and their relation to the tubercle bacillus. He classes them according to their pigment production on artificial media into three groups: *Str. albus*, *Str. flavus*, and *Str. violaceus*. Those of the first group are not acid-fast, those of the second group only slightly so, whereas those of the third group are completely acid-fast. Among the first series two were pathogenic for animals with lesions indistinguishable from tuberculosis; in the second group none were pathogenic; and in the third group almost all gave virulent cultures pathogenic for animals, and producing tuberculous lesions containing acid-fast organisms.

Renal Tuberculosis in a Carp.*—Hautefeuille describes a case of tuberculosis in a carp. For some weeks it had presented a tumour the size of a nut, on either side of the body about the region of the posterior orifice, and below the lateral line; the tumour was covered by the integuments, was soft and fluctuating, that on the left side was slightly larger, and had two small ulcerations, from which exuded a thick yellowish liquid which was found to contain a large number of small bacilli 3 μ to 6 μ long, some being free, others being included in the cells; these rods stained only faintly by ordinary dyes, but after half an hour in warm or cold carbol-fuchsin they resisted decoloration by chlorhydrate of anilin. Various media were inoculated from the contents of the tumour, and incubated at 37° C. and 25° C. The autopsy of the animal showed that the alimentary canal, liver, spleen, and branchii were healthy, but in the heart blood were found many bacilli. The kidneys were found to be incorporated in the pathogenic tissue of the tumour on either side; this tissue consisted of a gelatinous mass of small embryonic cells and many giant cells, all containing bacilli, and side by side with these were renal glomeruli.

The cultures that were incubated at 37° C. gave negative results, but those at 25° C. commenced on the third day. In broth there was no cloudiness, but a flocculent deposit, which was more vigorous in glycerin-glucose broth; on potato there appeared on the fourth day round yellow-white granular colonies with a wrinkled and slightly fatty aspect; growth was less vigorous on agar, the milky white colonies not appearing till the fifth day; no growth was obtained on gelatin direct, but by subculturing on gelatin from the first broth tube, and incubating at 12° C., faintly visible colonies appeared on the eighteenth day; the gelatin was never liquefied; sub-cultures on potato at 32° C. grew at the end of four days. The bacilli of the cultures presented the same characters as those seen in the tissue; in the older cultures they were larger and sometimes showed branched forms; they stained very feebly with the ordinary dyes, but resisted the decoloration by dilute acids; the odour of the older cultures reminded one of that of peach blossom.

Carp of the same species inoculated with the pulp of the tumour died at the end of six days, with bacilli in the heart blood, liver, kidney, and spleen, but no reproduction of a similar tumour could be obtained. A frog inoculated intraperitoneally with the pulp of the tumour died after two months with bacilli in the blood, and numerous granulations in the peritoneum; a second frog survived only three weeks; a sub-

* Mem. Soc. Linn. (Amiens, 1904), p. 223.

sequent inoculation of a carp showed that by the passage of the organism through the frog its virulence had been increased. A guinea-pig survived the inoculation from the initial pulp for three months. The bacillus appeared to be pathogenic for cold-blooded animals, but innocuous to the warm-blooded. The author considers that the original infection was by the ingestion of human tuberculous expectoration in the aquarium water.

"Barszcz."*—M. K. Panek describes the bacteriological and chemical aspects of "Barszcz," a fermentation product of beetroot, largely used as a food, especially in invalid diet, in certain parts of Poland. The beetroot is cleaned, peeled and cut in slices, and placed in an earthen vessel, and covered two or three fingers deep with soft water; after standing in a warm place for several days fermentation sets in, and after a week the process is complete, and the Barszcz is filtered through linen and placed in the cellar; it is a viscid thread-like fluid of a raspberry-red colour, aromatic smell, and pleasant, sweet, acid taste. The author finds that this fluid is the result of a slime fermentation caused by a specific micro-organism, *B. betæ viscosum*, present in the macerating liquid of the beetroot at 18°–20° C.; at a higher temperature than 25° C., the beet juice undergoes lactic fermentation, which makes it sour. *B. betæ viscosum* is a non-motile short rod $0 \cdot 5 \mu$ broad by $0 \cdot 8 \mu - 1 \cdot 0 \mu$ long, with rounded ends, and is often arranged in pairs and chains, and on sugar-free media has a coccal appearance; it stains well by aniline dyes, and by Gram. On sugar-free broth there is but slight growth, the fluid remains clear, and after several days only a very small deposit is formed; in 2 p.c. dextrose broth there is cloudiness and abundant deposit; in saccharose broth at 17°–20° C., the medium is clouded and converted into a slimy mass from the production of dextran. On gelatin plates it grows minute colonies 0·3 mm.–0·5 mm. in diameter, which are readily removed from the surface, have a golden-yellow colour by transmitted light, show a finely granular structure, and round, regular, transparent margins; the gelatin is not liquefied. On cane-sugar gelatin plates after 48 hours, transparent drop-like surface colonies are formed, which later become irregular in shape from the production of slime, they unite with each other, become cloudy, and appear as a slimy, stringy fluid. On ordinary agar, small dewdrop colonies are formed, that later run together but do not produce slime. On 10–20 p.c. cane-sugar agar slime is formed, and later there is softening and liquefaction of the agar. Milk is coagulated after the sixth day. On potato there is a barely perceptible growth and no slime production; but on beetroot after two days, there appears a shining carmine-red slimy film that spreads over the surface. The optimum temperature is between 17° and 20° C.; at 30° C. there is good growth, but only slight production of slime; at 37° C. the growth is slight, and there is no formation of slime; it is killed after five minutes at 64° C. It is a potential anaerobe.

Bacterial Infection of Cabbages.†—G. Delacroix describes a disease occurring in several varieties of cabbage, especially in the cauli-

* Anzeig. Akad. Wiss., i. (Krakau, 1905) p. 5.
† Comptes Rendus, cxl. (1905) p. 1356.

flower, but not found in the Brussels sprout, and characterised by a necrosis and livid coloration of the leaves affected. On microscopic examination the diseased cells were seen to contain a number of bacteria which the author has shown to be the cause of the disease. The organisms are motile rods with blunt ends, $1 \cdot 25\,\mu$–$1 \cdot 75\,\mu$ long and $0 \cdot 5\,\mu$–$0 \cdot 75\,\mu$ broad; they grow well on ordinary media, which acquire a pale green fluorescent colour after the second day, and later become brown and lose their fluorescence. Broth becomes clouded, has a dirty white deposit, and in young cultures there is a delicate pellicle; on gelatin it forms small shining convex circular colonies of a dirty white colour, the gelatin not being liquefied; on agar similar colonies are formed, but the green coloration of the medium is less than on the gelatin; potato is coloured a vivid brown; no production of gas was observed on any medium. The organism stains by ordinary dyes but not by Gram. The presence of spores or flagella could not be demonstrated. The author has assigned it the name of *Bacillus brassicævorus*. Several species of cabbage were successfully infected both from the pulp of the diseased plant and from the first culture of the bacillus; the pathogenic action of the tissue is probably caused by a bacterial secretion. The author considers that this disease is distinct from that caused by *Pseudomonas campestris* (Erwin F. Smith), and also from that produced by *B. oleraceæ* (F. C. Harrison), since it differs from these both in the appearance of the disease and in the characters of the organism.

Swine Septicæmia.*—Grips, Glage, and Nieberle have made a detailed study of this subject, and give a description of the symptoms and course of the disease, also its morbid anatomy, epidemiology and bacteriology. They find that it affects young animals, chiefly pigs; that cold, change of food, and rough weather increase the severity of the disease, and that its prevalence rises with the onset of winter. The incubation period is 3–17 days; fever and increased frequency of the pulse is not the rule: indeed, in fatal cases the temperature is usually subnormal. The infection is characterised by catarrh of the mucous membranes, suppurations and severe inflamations, nervous symptoms, digestive disturbances, and skin eruptions. The authors find that the disease is caused by the *Grips bacillus*, varying sized rods that exhibit neither motility nor spore formation; it stains well by basic anilin dyes, especially with carbol-fuchsin, but only feebly by Gram; it grows either aerobically or anaerobically, but with frequent subculture it loses its vitality; it grows best at blood heat, and serum and milk are the most favourable media; colonies appear on serum after 2–7 days, and later the medium is almost completely liquefied; in serum broth a grey flocculent deposit is formed. Sterilised milk appears to be a more certain medium than serum; in 24 hours there is a good growth, and after 48 hours the milk has begun to clot, and a clear whey separates out after 4 or 5 days. This organism is only rarely pathogenic for guinea pigs; for white mice it is fatal after intraperitoneal injection; rabbits die in 3–5 days after an intra-peritoneal injection of 7 c.cm. showing at the autopsy numerous encapsuled abscesses in the abdominal

* Centralbl. Bakt., Ref. 1te Abt., xxxviii. (1905) p. 488.

cavity; from these abscesses pure cultures of the bacillus can readily be obtained.

Clostridium Polymyxa Prazmowski.*—M. Gruber identifies with this organism a bacillus that he isolated from pasteurised milk, the decomposition of which he attributes to this organism. Pasteurised milk was kept in sterile Erlemeyer flasks at 18°–20° C.; after decomposition had taken place and the clear whey had separated from the casein clot, he distributed portions of these into tubes of broth, and after shaking them up thoroughly they were exposed to 98° C. for one minute, and from these broths were made anaerobic shake cultures and three dilutions of aerobic glucose-agar plates; the shake cultures after several days at 34° C. showed a number of colonies of the same variety of bacillus, all of which produced the characteristic decomposition of sterilised milk. The bacillus varies in length from $3\cdot50\ \mu$ to $7\cdot0\ \mu$; the young individuals are distinctly motile, and peritrichous flagella can be demonstrated with difficulty; spore formation occurs in aerobic cultures, but growth is better under anaerobic conditions. On gelatin the surface colonies have peculiar irregular fantastic margins with small worm-like processes; after a few days the gelatin commences to liquefy; in broth after 24 hours there is a general cloudiness and a formation of gas, and after 2 or 3 days a pellicle and a slimy thready deposit are noticeable; in the pellicle the rods are spindle-shaped and exhibit spores that are either central or polar; it ferments mannite, glucose, maltose, galactose, xylose, arabinose, raffinose, and methylglycosid, and cane sugar, but does not ferment lævulose.

HERZOG, M.—**The Plague, its Bacteriology, Morbid Anatomy, and Histopathology, including a consideration of Insects as Plague Carriers.**
Pub. Bureau Govt. Lab. Manila, No. 23 (1904) 149 pp., 27 figs.

WHERRY, W. B.—**Glanders, its Diagnosis and Prevention, together with a Report on Human Glanders, and notes on the Bacteriology and Polymorphism of Bacillus mallei.**
Op. cit., No. 24 (1904) 27 pp., 7 pls.

WRIGHT, J. H.—**Biology of the Micro-organism of Actinomycosis.**
Pub. Massachusetts Gen. Hosp., i. (1905) pp. 1–56 (10 pls.).

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* Centralbl. Bakt., 2te Abt., xiv. (1905) p. 353.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Koristka's Large Model Mineralogical Microscope.†—This instrument (fig. 85), fitted with the most recent improvements, was constructed under the direction of Professor L. Brugnatelli.

The upper end of the pillar is elongated, in order to allow the use of auxiliary apparatus, such as a Klein's or Federow's plate.

The rotatory stage has a diameter of 120 mm., is divided into degrees, and has a vernier reading to 10′ and even 6′. It also has rectangular movements, with micrometer adjustments, the milled heads of which J K are divided up to 0·01 mm. and 0·04 mm. respectively.

The illuminating apparatus has a special fitting for instantly removing the condenser, and for changing from convergent to parallel light, or *vice versa*.

The polariser is raised by a rack-and-pinion N, and has an iris diaphragm with graduated collar R. The screw-head H is for centring the objectives, and the slit I for a Klein's quartz or other accessory.

The analyser G is easily thrown out of the field, has a rotation of 90° and a graduated scale F. It is supplied with a special lens for maintaining the focal length of the optical system. The ocular tube is moved up and down by rack-and-pinion B; it has a displacement of 36 mm. and has mm. divisions for marking its position.

At its lower end it is fitted with a diaphragm D, and also has a slit C, with a Bertrand lens for observing the axial image.

The upper end of the ocular tube is adapted for the reception of a second analyser, having a circular graduated scale, and also for the insertion of any kind of eyepiece.

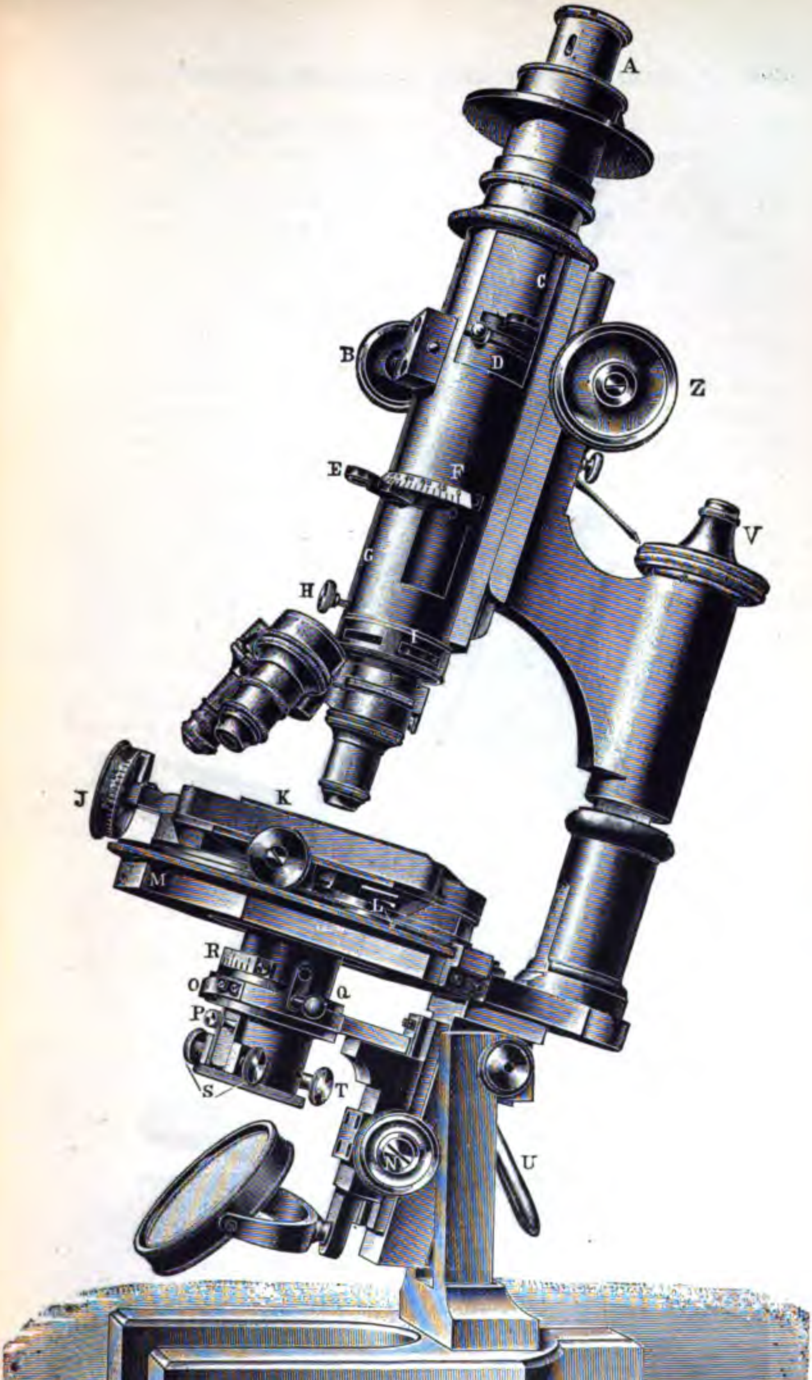
Leitz' Mineralogical Stand No. I.‡—This instrument (fig. 86) corresponds in its dimensions to Stand No. I. in the maker's catalogue. The coarse adjustment is by rack-and-pinion; the fine, by Leitz' new fine adjustment with side-knobs,§ the drum being divided into 100 parts, so that one graduation means a movement of 0·001 mm. Condenser, iris diaphragm, and polariser are raised and lowered by a lateral screw. A three-limbed condenser with iris diaphragm facilitates convenient observation of the axial pictures in the Microscope. Both the upper lenses of the condenser can be drawn out by a lateral lever if one wants to change

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus: (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Koristka's Catalogue, No. 12, Turin, 1905, p. 31, fig. 15.

‡ Catalogue No. 41 (Mikroskope) 1905, pp. 59-61.

§ J.R.M.S. 1903, pp. 667.


A
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F. KORISTKA MILANO
C. WERNER - MILANO

Fig. 85.

Fig. 86.

from convergent to parallel light. By a connecting-piece applied to the tube end, the objective is centred on the rotation centre of the rotatory object stage, which is graduated into 360° with a vernier. The stage has orientation marks, and there are two drum-graduations at the side of the stage for reading off lateral movements, which can be performed up to 20 mm. The Nicol polariser can, after the removal of the iris carrier, be drawn out of the screw from below, and an illuminating apparatus with iris can be inserted instead. The zero of this Nicol is marked, as well as the 90°, 180° and 270°. The analyser, in a metal collar, is placed above the ocular, and rotates on a rim rigidly connected with the ocular mount. This rim is graduated into 360°. On the front side of the tube is a flap, which can be opened or closed, and through which access can be had to the inner tube. In this flap is a slit for the Bertrand lens, and under the lens is an iris for the sharp delimitation of the interference figures.

Leitz' Demonstration-Microscope.*—This instrument, shown in fig. 87, is intended for weak and medium magnifications. The stage is rectangular with rotatory diaphragm. The tube-adjustment is by push action and a clamp-ring. A fine adjustment, condenser, and iris can be adapted if desired.

FIG. 87.

Leitz' Mineralogical Stand No. II.†—The instrument (fig. 88) now issued with this title (maker's series, No. 38) is a somewhat simplified and smaller form of the same firm's Mineralogical Stand No. I., previously described in this Journal,‡ their former No. II. having now become Stand No. III. The coarse adjustment is by rack-and-pinion, the fine by micrometer screw, a division signifying a movement of 0·01 mm. The condenser, iris and polariser can be raised and lowered by a lateral screw. A three-limbed condenser allows the convenient observation of the axial images in the Microscope; both the upper lenses can be put out of action by a lever. By means of an intermediate piece applied to the tube-end the objective can be centred on the centre of the rotatory object-stage, which is graduated into 360° and fitted with a vernier. The stage also has graduations for orientation. The polarising Nicol can after the expansion of the iris be drawn out from underneath. The zero of this Nicol is marked, as also the 90°, 180°, 270°. The analyser rotates on a disc, whose circumference is

* Catalogue No. 41 (Mikroskope) 1905, p. 51.
† Tom. cit., p. 63. ‡ J.R.M.S., 1903, p. 758, fig. 163.

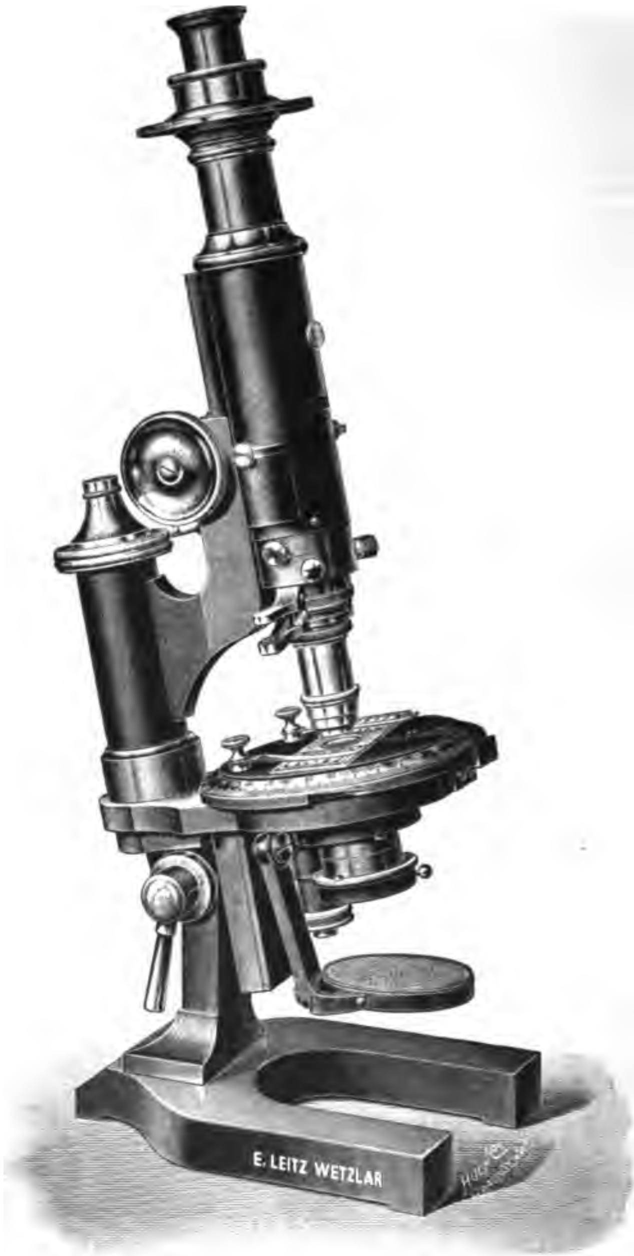

Fig. 88.

divided into 360°. On the front of the tube is a slit for receiving the Bertrand lens.

Leitz' Mechanical Stage.*—This (fig. 89) is an improvement on the earlier form noticed in this Journal.† It will be seen that the horizontal pinion goes right through the stage and carries a milled head at each end. The previous pattern had the screw-head only on the right-hand. The two rectangular movements are fitted with scales and verniers. The ranges are respectively 50 and 30 mm.

Object-stage, with Sliding Measurement Adjustment.‡—J. Tuzson and M. Herrmann have sought to produce a measuring apparatus which should be accurate, easy to manage, and independent of the lens

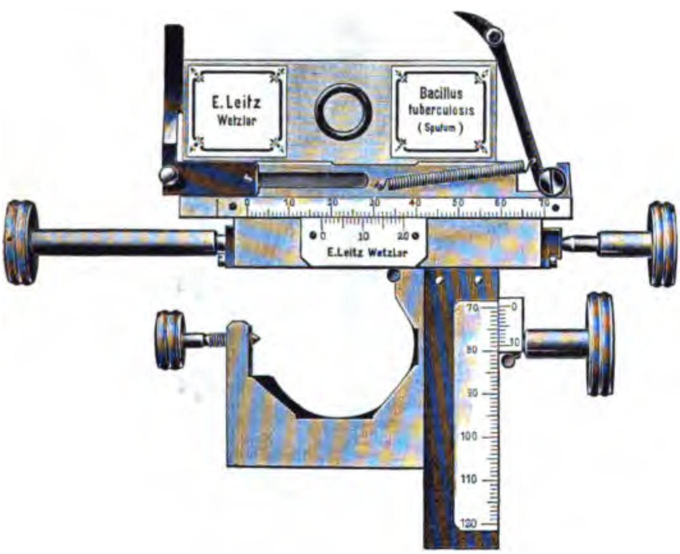

Fig. 89.

system. The principle of their method consists in pushing the object under the fixed cross-threads of the ocular by means of a specially constructed micrometer screw. The amount of the push-movement is obtained by direct reading and without calculation.

The general appearance of the apparatus is shown in fig. 90, and in section in fig. 91. The rotatory object-stage A is of ordinary construction, and, by means of a hollow circular flange (conical in section), works in the slide-rest B without play. This slide can be urged backwards and forwards in a straight line in a prism-groove of the ground plate C, which is rigidly attached to the Microscope stand. The arrangements are such that the Abbe illumination is unaffected, and the movable

* Catalogue No. 41 (Mikroskope) 1905, pp. 83–4.
† J.R.M.S., 1904, p. 105.
‡ Zeitschr. wiss. Mikrosk. xxi. (1904) pp. 189–99 (4 figs.).

parts have a push-range relative to the motionless parts of 5–6 mm. The movement of slide and rotatory object-stage is actuated by the micrometer screw D working in a bearing which is of same piece as the ground

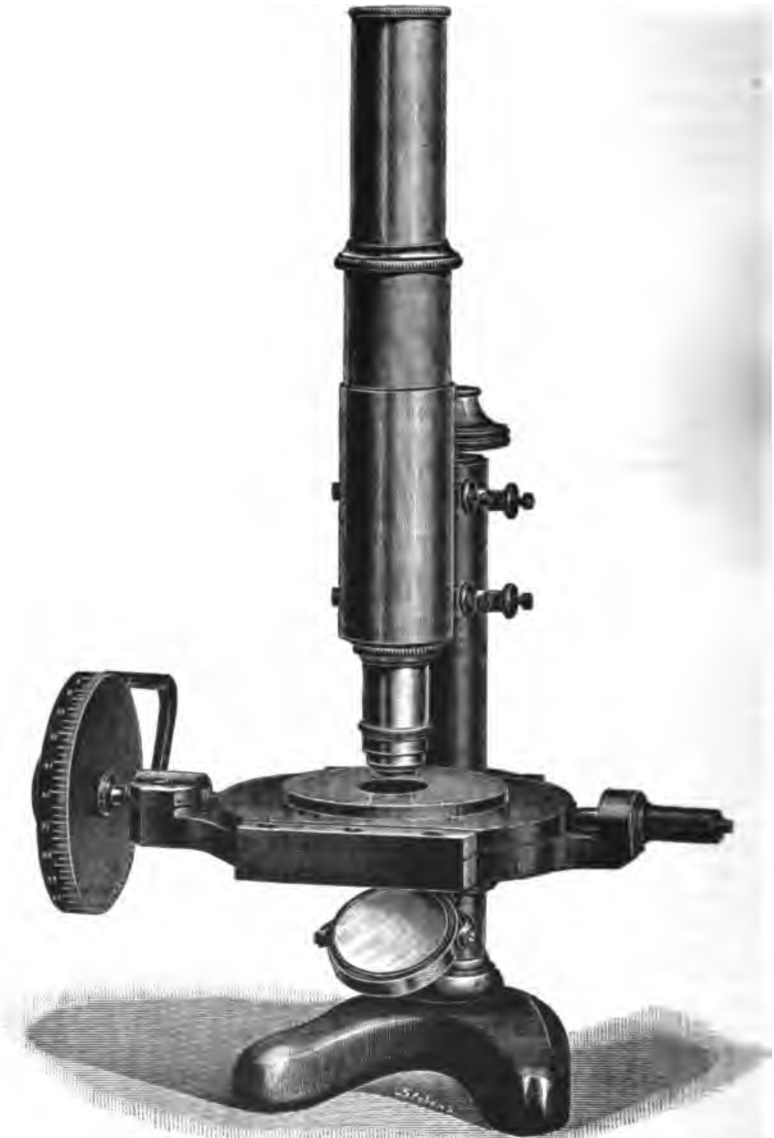

FIG. 90.

plate. The slide is actuated by the rounded end of this micrometer screw, and at the other end presses against the spring and rod E. All movements involved are exact and free from looseness. The screw and rod are accurately co-axial. A graduated drum F regulates the movement of the micrometer screw, and a pointer attached to the ground plate facilitates reading. The graduations are so arranged that zero corresponds to the position where the tube-axis coincides with the centre of the rotatory stage (i.e. the medium position); whole rotations of the micrometer screw are read off on the pointer, while fractions are given by the drum. One rotation of screw gives a length-movement of 0·5 mm. The drum is 66 mm. in diameter, and its circumference is divided into 500 parts, so that a rotation of one division gives a slide-movement of

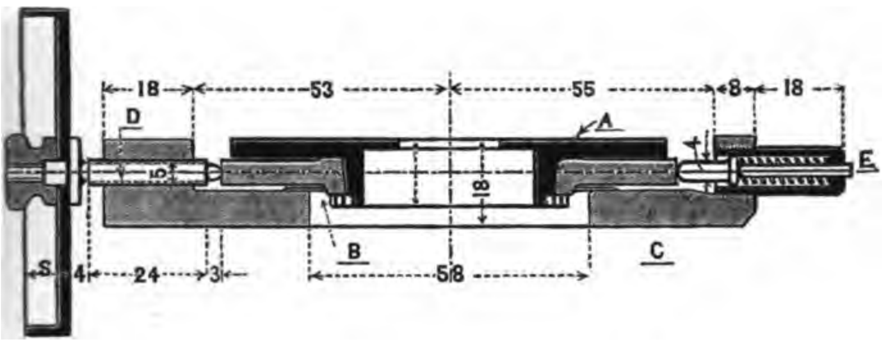

FIG. 91.

about 1 μ; thus readings can be taken directly to the thousandth of a millimetre, and, by estimation, to the ten-thousandth. The apparatus affords five complete rotations of the drum forwards and backwards, and therefore a total movement of the stage of 5 mm., which is sufficient for the purpose. The authors point out that the apparatus would also be serviceable for centring objective and ocular, and for orientating objects. Satisfactory tests of accuracy were made.

HIRSCHWALD, J.—Über ein neues Mikroskopmodell und ein "Planimeter-Okular" zur geometrischen Gesteinsanalyse. *Centralbl. f. Mineral.*, 1904, p. 626.

KÄSEWURM—Neue Trichinenschaumikroskope. *Zeit. f. Fleisch. u. Milchhygien*, Bd. xiv. (1904) p. 269.

MEYER—Das Ultramikroskop. Kosmos, Bd. i. Heft i.

RINNE, F.—Le Microscope polarisant. Traduit par L. Pervinquière, avec préface par A. de Lapparent. Paris, 1904, 160 pp.

(2) Eye-pieces and Objectives.

New Formula Object-glass.—Messrs. Leitz, of Wetzlar, have lately introduced two new object-glasses, viz. a $\frac{1}{8}$ and $\frac{1}{8}$, on an entirely new plan. They may be described as semiapochromats containing fluorite. In these we have a new type of lens, which is neither a semiapochromat

nor an apochromat, but something between the two. They might, therefore, be appropriately called ¾ apochromats. These glasses are of very high quality, and their price is but little in advance of that of the makers' ordinary lenses.

Leitz' New Objectives.*—The Wetzlar firm has now produced achromatic fluorite objectives, numbered 6A and 7A respectively. The colour correction is more perfect than in Nos. 6 and 7, but the magnification and numerical quantities are unaltered. The details are—

	Focal Length.	N.A.	Micrometer Value.
No. 6A	4·4 mm.	0·82	3·5 μ
No. 7A	3·2 "	0·85	2·6 μ

The Notation of Microscopical Objectives.†—L. Malassez inquires whether it may not be possible to evolve a uniform system of notation applicable to all objectives. He points out how various and defective all existing methods are, and expresses the opinion that objectives should evidently be designated by some indication of their magnifying power. The differential character of objectives depends chiefly upon the range along the principal axis of the ultimate position of their *characteristic* (i.e. the line forming the limit of all the magnifications which the objective is capable of producing). The more remote this ultimate position the greater the magnification produced. To a smaller extent the differential character depends also upon the position of posterior focus of the objectives; the more remote this focus, the greater the magnification. The objective notation should then be based upon these qualities. As regards the distance of *characteristic*, the author proposes to represent it by what he calls the *specific magnification*, viz. that produced by the objective at each increasing unit of distance, or, in other words, that which it produces at unit distance from its posterior focus. The decimeter should be taken as the unit of distance. This *specific magnification* γ can be evaluated in various ways: it may be obtained by merely using micrometric oculars and taking any two magnifications whatever (G, g), and noting the distance δ between them; it can be shown that $\gamma = \frac{G - g}{\delta}$. Among other methods the author recommends the use of the Weiss focimeter. As regards the position of the posterior focus, the author proposes the epithet *posterior foco-facial* for the distance between this focus and the posterior (or issuing) face of the objective. Moreover, as this posterior focus is sometimes behind this face (weak objectives), sometimes in front of it (strong objectives), he employs the letters p (post) and a (ante) to express the two cases respectively. This distance, ϕ_p or ϕ_a, can be easily calculated if one knows the specific magnification γ of the objective, any magnification g produced by it, and the distance d between the position of magnification and the pos-

* Catalogue No. 41 (Mikroskope) 1905, p. 14.
† Arch. Anat. Micr., vii., fasc. ii. pp. 270–350 (8 figs.).

terior face of the objective. It can be shown that $\phi_p = d - \frac{g}{\gamma}$ and $\phi_a = \frac{g}{\gamma} - d$. These relationships can also be obtained by graphic constructions. The notation is thus established by means of two figures, without complicated formulæ or special apparatus—merely by help of ordinary microscopic auxiliaries. A number of interesting facts regarding a lens may be easily deduced from γ and ϕ, including a graphic diagram. Again, the first of the two figures would be the ordinary title of the lens, the second (ϕ) could be engraved on the mount. Thus objectives would be known by figures giving their magnifying power at the same distance, viz. 1 decimetre from their posterior face. The author suggests that makers should, in anticipation of the universal adoption of his scheme, supplement their ordinary descriptions of objectives by two columns recording the new notation. This is now actually being done by one maker, Stiassnie, of Paris, who has materially helped the author with the necessary information and apparatus for drawing up the lists and tables in the treatise.

Theory of Symmetrical Optical Objectives.*—S. D. Chalmers, as the result of his investigation, concludes that, subject to the errors introduced by the want of correspondence of the stop and its image, the combined system is completely corrected for astigmatism, curvature of field, and spherical aberration, provided the back component is so corrected. This want of correspondence, however, introduces some slight errors, but in practical systems these are almost negligible.

Construction of Aplanatic Combinations of Lenses with or without Achromatism.†—"H" discusses this subject in a series of four letters to the "English Mechanic," illustrated by very clear diagrams. He takes, as his model, the lens figured by Engel in plate xi. of Schellbach's "Geometrical Optics." The writer's design is to simplify the subject as much as possible, and his method is a combination of graphics with calculations from Halley's formulæ. These classic formulæ have the advantages of (1) great simplicity and clearness; (2) absence of all error from incomplete recognition of the effect of "thickness"; (3) the comparatively small number of figures needed in working out the details; (4) the accurate way in which they may be got to supplement a partly graphic method, as both deal with one surface at a time. The formulæ are—

$$f_1 = \frac{m\,d\,r}{(m - n)\,d - n\,r} \qquad f_2 = \frac{m\,d\,r}{(m - n)\,d + n\,r}$$

$$f_3 = \frac{m}{m - n} \times r \qquad f_4 = \frac{m\,d}{n}$$

where $\frac{m}{n}$ = ratio of refraction, d = distance of radiant, r = radius of curvature of surface.

* Proc. Roy. Soc., lxxiv., No. 482, pp. 267–72; No. 504, pp. 396–9 (3 figs.).
† English Mechanic, Nos. 2068, pp. 321–2; 2069, p. 340; 2072, pp. 406–8; 2080, pp. 595–6.

Leitz' Camera Ocular.*—This auxiliary apparatus (series No. 93) is shown in fig. 92. The distinction between this and other forms of such apparatus made by the Wetzlar firm, is that the drawing plane lies horizontally on the work-table directly in front of the observer. This

FIG. 92.

is effected by inclining the Microscope at an angle of 45°, and by employing a somewhat changed form of prism. The diminution of the light is attained by the use of two neutral-tinted glass discs set in movable arms.

BLAKESLEY, T. H.—**Single-piece Lenses.**
Proc. Phys. Soc., London, xviii. (1903) p. 591.

CONRADY, A. E.—**On the Chromatic Correction of Object-glasses.**
Monthly Not. Roy. Astron. Soc., lxix. (1904) p. 274.

FÉRY, CH.—**Méthode nouvelle pour la Détermination des Constantes des Lentilles.**
Bull. Soc. Franç. de Phys., 1903, p. 226.

SPITTA, E. J.—**Improvements in Modern Objectives for the Microscope Popularly Explained.**
[The author reviews the chief defects of lenses, and shows how Jena glass is adapted to neutralise them. He emphasises Abbe's labours in this field.]
President's Address, Journ. Quekett Micr. Club, Feb. [illegible] pp. 141–52 (2 pls., 12 figs.).

TROZEWITSCH, S. E.—**Anfertigung von Objecktiven für Teleskope, Mikroskope und Photographische Apparate, die Optische Technik der Mikroskope und Teleskope (Russisch).**
Warsaw (1903) 322 pp.

" " **Zur Frage über das Aplanatische System.**
Zeits. f. Math. u. Phys., li., (1904) p. 100.

(3) Illuminating and other Apparatus.

Leitz' Apparatus for Observation of Ultra-Microscopical Particles.†—This apparatus is shown in fig. 93. It consists of a plate applied to the object-stage and clamped to the pillar. This plate contains a small chamber through which, by means of an india-rubber tube, the liquid for examination is conducted. The rate of flow is controlled by a stop-cock, and a small window admits light into the chamber. The fluid may be observed bare or protected with a cover-glass. The

* Catalogue No. 41 (Mikroskope) 1905, p. 80. † Tom. cit., pp. 66–67.

chamber can be replaced by a small stage for the examination of solid bodies such as ruby glass. Illumination is by arc-light, or by mirror-reflected sunlight, and the light after passing through a diaphragm tube is concentrated by a lens on a slit arrangement, which is adjustable on both sides; the length and breadth of slit are both measurable by drum

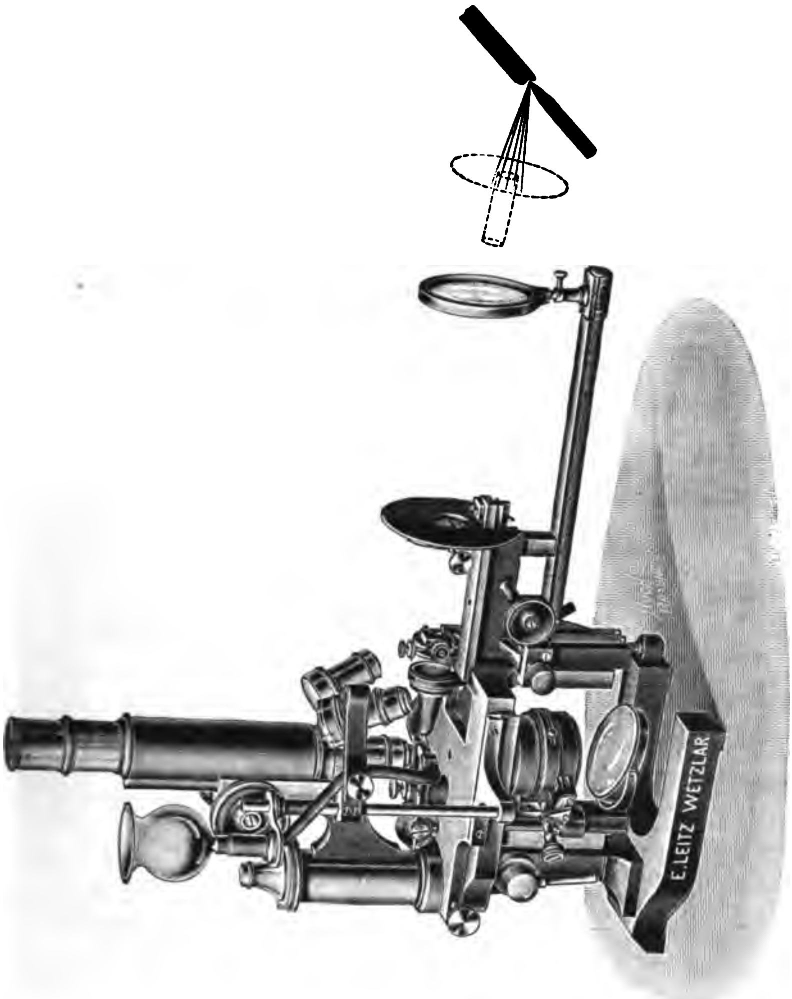

FIG. 93.

graduations. The slit can be rotated through 90°. A stronger, adjustable objective focuses the slit into the field of view. The optical axis with lenses, etc., can be arranged vertically or horizontally.

For obtaining dark-ground illumination, a special objective and diaphragm are used (figs. 94, 95). Behind the optical part of an objective a spring stamp-diaphragm is screwed, which presses against

the rear lens. Leitz' immersion objectives are particularly convenient for this arrangement. The effect is to make the objects (e.g. bacteria) appear bright on a dark ground even with the strongest ocular magnification.

FIG. 94.

FIG. 95.

Leitz' Universal Projection Apparatus.*—This apparatus is adapted for diascopic, microscopic, and episcopic projection, the last being

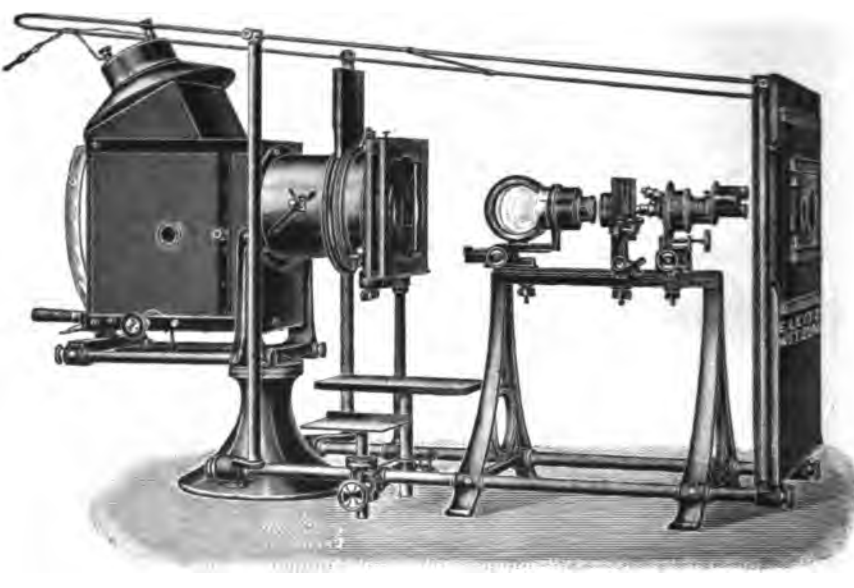

FIG. 96.

attainable with either downward or lateral illumination. The essential characteristic in all is that, owing to direct illumination of the object,

* Catalogue, No. 41 (Mikroskope) 1905, pp. 91-4.

an unusually brilliant image is projected. The self-regulating lamp has a current-strength of 30 amperes and 48 volts E.M.F.; higher voltages must have a corresponding rheostat equipment. The lamp can be centred, and has a three-fold adjustable collective lens system of 210 mm. diameter, and is protected from the heat by a hard glass disc. A cooling chamber stands in front of the lenses. The arrangement for *microscopic projection* (fig. 96) consists of a two-fold condenser, large cross-stage with preparation cooler, Microscope tube with iris, rack-and-pinion adjustment, micrometer screw, triple objective, and ocular revolver, all mounted on an optical bench.

For *diapositive projection* the movable stage with Microscope tube

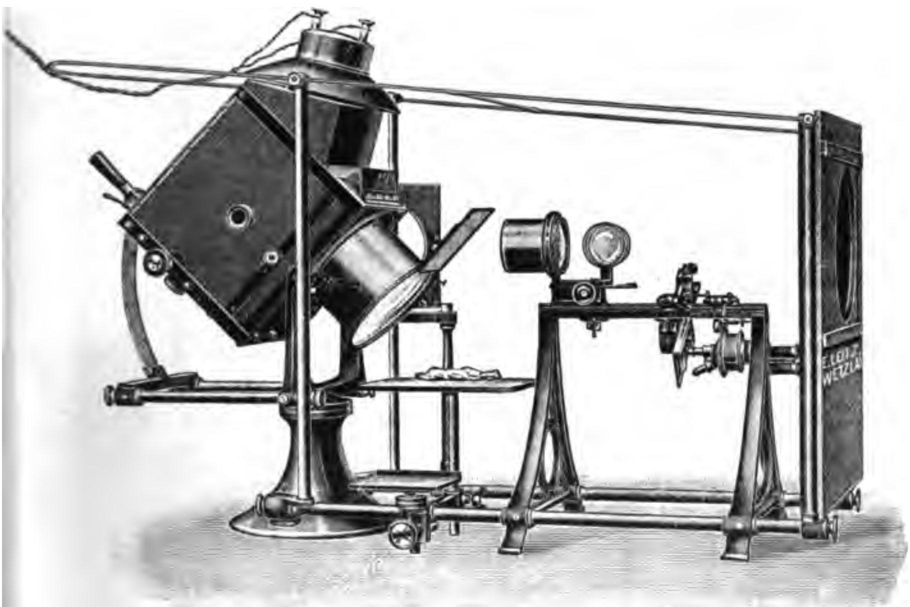

FIG. 97.

is, by means of a hinge, swung aside. Simple projection objectives are set up in lieu of the Microscope condenser. A diapositive holder, with exchange-frame and apertures 13 by 13 cm., and a plate with clamps for projection of larger section-preparations, are placed before the large cooler.

For *episcopic projection with downward illumination* (fig. 97) the lamp is slanted upwards on a strong axis in a vertical plane at an angle of 45°, and the object placed on a large stage is thus illuminated. The projection objective of 400 mm. focus is rotated into the optical axis. A mirror over the lens-system receives the image and reflects it at 90° into the projection-objective.

For *episcopic projection with lateral illumination*, the lamp takes a horizontal position, but is rotated laterally through 45°. A smaller object-stage, adjustable vertically, is set up laterally; the mirror is rotated 90°, and projection takes place as before (fig. 98).

The whole apparatus is screened with black curtains, and on the front is a round opening, reducible, at pleasure, for the different kinds of projection.

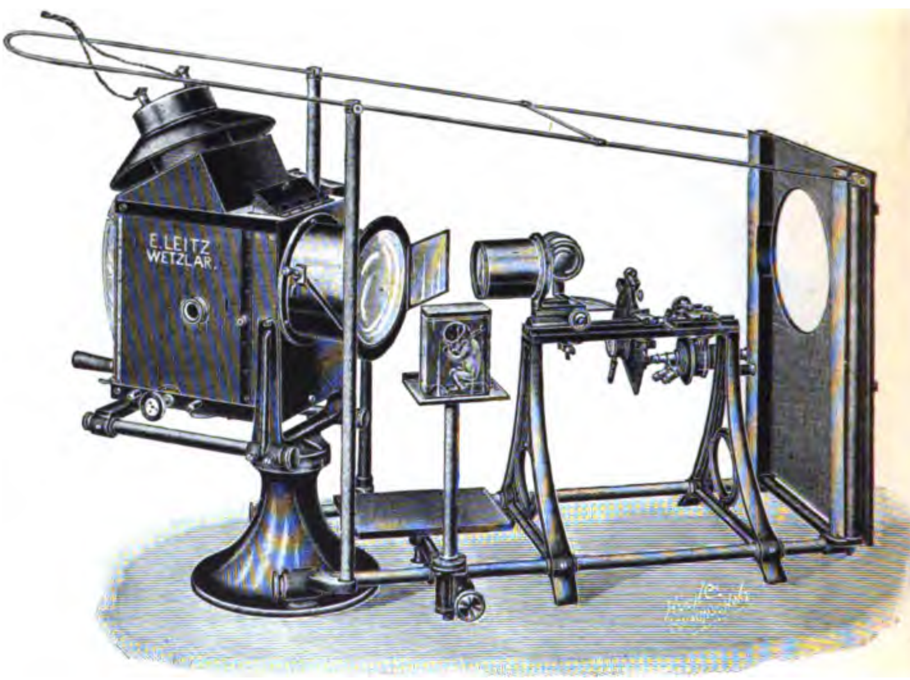

Fig. 98.

New Vertical Illuminator for Metallurgical Examinations.*— The firm of R. and J. Beck has brought out a new vertical illuminator of the prism type, fitted with an iris diaphragm beneath the prism for cutting off outside light, and a plate of stops so arranged that the position of the beam of light impinging on the prism can be varied until parallel light of the right angle is obtained (fig. 99).

The principle is that a beam of light sent at right angles to the optic axis of the Microscope is reflected by a prism or piece of cover-glass, down upon the object, so that each objective acts as its own condenser. It is probably the only means of illuminating objects mounted dry when

* Knowledge, ii. (1905) p. 43; R. and J. Beck's Special Catalogue, 1905.

they are examined with immersion lenses, though in this case it is necessary that the object should be in actual contact with the cover-glass.

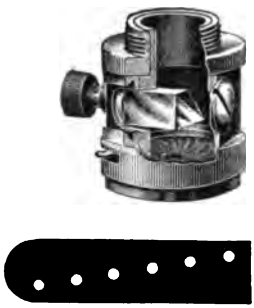

FIG. 99.

FIG. 100.

Monochromatic Trough.*—This trough (fig. 100), made by the firm of R. and J. Beck, is 4 by 3 by 0·8 in. in size, and is easily adjustable as to height and angle. It may be filled with fluid of any tint, though the saturated solution of copper acetate is that most often required.

Leitz' Triple Revolver with Large Protection Diaphragm.†—This is clearly shown in fig. 101.

FIG. 101.

Leitz' Thermometric Stages.‡—The Schultze pattern is shown in fig. 102. A metal stage bears at its sides wing-like projections under which the heating flame can be applied. Observation is carried on by a

* R. and J. Beck's Special Catalogue, 1905.
† Catalogue No. 41 (Mikroskope) 1905, p. 110. ‡ Tom. cit., p. 85.

condenser lens with large magnification. The temperature is indicated by a thermometer and can be extended up to 100° C.

In the Stricker pattern the stage forms a metal chamber through which warm water can be passed. A condenser lens and thermometer are used, as in the last. The stage can be screwed to a table.

FIG. 102.

Leitz' Drawing Board (Simple Form).* — This is shown in fig. 103 inclined at 12°, at which angle it is adapted for use with Leitz' camera ocular, series No. 92.

FIG. 103. FIG. 104.

Fig. 104 shows Giesenhagen's drawing board. In this apparatus the board may be adjusted at various angles, and raised or lowered with facility.

* Catalogue, No. 41 (Mikroskope) 1905, p. 81.

Polariscope.*—E. Holmes writes that a good polariscope for some purposes may be made by black varnishing two sheets of glass, and so placing them that the light reflected from one lying flat on the table is again reflected to the eye by the second plate. Objects to be examined are placed in the beam of light. There is no gain whatever in using a pile of plates for a reflecting instrument in this way. A dozen microscopical cover glasses put in a paper tube at an angle of about 57° make a good analyser. Whatever the number of plates the angle remains the same for maximum effect.

The Micro-pantograph as a Drawing Apparatus.†—G. C. van Walsem has re-designed this instrument (fig. 105), which was originally contrived in 1872 by J. Roberts. It is described by von Apáthy in his

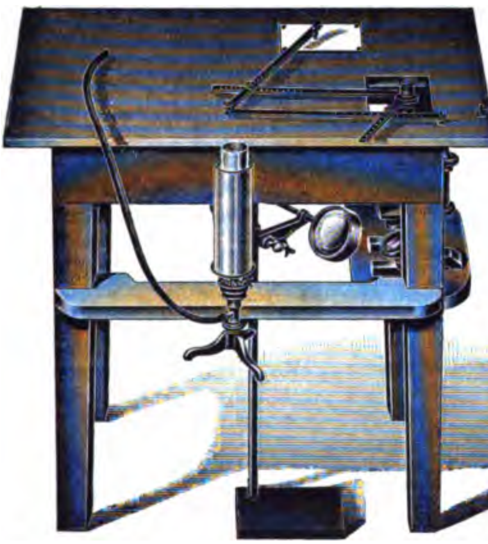

FIG. 105.

"Mikrotechnik der tierischen Morphologie."‡ Roberts' instrument, however, had the disadvantage of reproducing the microscopic image reversed. The essential feature of Walsem's improved form is a special double ring-link which embraces the "object-point," i.e. the Microscope tube. The diameter of this ring is 37 mm., so that the ring is large enough not only to encircle the tube and to be moved freely about within certain limits without jarring it, but its centre in the case of a weak ocular and a correspondingly large ocular diaphragm can be made to explore the whole field. It is obviously important to reduce friction as much as

* English Mechanic, lxxxi. (1905) p. 383.
† Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 166–72 (2 figs.).
‡ Zweite Abteilung, p. 361.

possible, and for this purpose the upper surface of the inserted ring has been cut out in such a way that it is in contact with the under surface of the other ring at only three points. The upper ring has in its rim a vertical slit for receiving a fine needle, or bristle, whose end should exactly coincide with the ring centre. A ring, corresponding to the thickness of the diaphragm, has to be soldered on to the ocular so that, when inserted into the tube, the ocular rests on this ring. About 1·5 mm. above this ring in the ocular is a cross-slit extending to about one-fourth of the circumference for receiving the bristle, which should now be sharply defined in the field of view, and should, moreover, be in its centre when the lens rings are concentric. The apparatus requires a special table (85 cm. high, long side 72 cm., short side 51 cm.). The observer sits at one of the short sides (we will suppose at the right of the figure) and at his left hand, 8 cm. from both long and short sides, is a rectangular hole 14 by 11 cm., the 14 cm. corresponding to the short side of table. The table legs are connected by a horizontal cross-board, whose upper surface is 52½ cm. above the floor. The difference of height between this surface and the table-top surface is just sufficient for the object-stage (17½ cm.) and extended draw-tube (170 cm.). In addition, the height of the pantograph and the height of the upper plane of the ocular must be allowed for. The "fixation-point" of the pantograph is seen at the observer's lower left hand. This point is secured by a knob with a pointed top, on which the pantograph hooks. There are, in reality, two of these fixation points: the one shown in use in the figure is 1 cm. from the rectangular hole, and is suitable for strong magnifications; the other, about 7 cm. away, is for weak magnifications. In the "stay-joint" (diagonally opposite to the object-point, or Microscope) of the pantograph is a rounded knob, which moves to and fro in the rotations about the fixation-point. A little wheel under this knob facilitates the motion and reduces the friction. The wheel, instead of moving on the wooden table-top, moves on a glass plate, thereby securing greater regularity and freedom of motion. The other joints produce a sliding movement of the bars relative to one another. An arrangement is made for artificial illumination, if required. The possible range of magnification was found to be between 2 and 10. This is, of course, quite independent of the ocular magnification, and, therefore, a strong eye-piece is recommended as giving sharper control in the tracing out of the outline. The framework should be made of L-shaped aluminium bars.

Koristka's Illuminator for Opaque Objects.*—This apparatus is principally intended for the study of metals. It is screwed to the Microscope tube, and contains a total reflexive prism which receives the light from the front and directs it by means of the objective on to the preparation. The prism occupies only half the field, thus leaving the other half free for vision. An iris diaphragm placed in front of the prism serves to regulate the light which it is to receive. By pulling out the arm which carries the prism the latter may be removed from the

* Koristka's Catalogue, No. 12 (1905) p. 50, fig. 56.

optic field, so as to leave it quite free. For use with this illuminator (fig. 106) a lens of 35 mm. diameter, and 72 mm. focus, is recommended.

FIG. 106.

Bausch and Lomb's Improved Form of Camera Lucida.* — The construction of this camera lucida (fig. 107) presents a number of improvements over older forms, although retaining the original optical principle. The Abbe prism is mounted in a closed box provided with a

FIG. 107.

rotating disc carrying a series of dark glasses of different shades. These glasses come between the prism and light from the Microscope eye-piece, and serve to moderate its intensity. A similar series of coloured glasses is arranged to moderate the light coming from the mirror. With the

* Catalogue A, 1904 (Microscopes and Accessory Apparatus) p. 68.

two series, a clear view of object and pencil point can be had with any combination of objective and eye-piece. The prism mounting has a centring arrangement, so that the aperture in the prism can be centred to the Microscope eye-piece, giving a clearly defined and equally illuminated image of the object. The prism can be turned back, permitting the use of the Microscope and the changing of eye-pieces without disturbing the camera lucida. The mirror is extra large, giving large drawings. The mirror bar is graduated in millimetres, and is movable, so that the distance between mirror and prism may be varied to suit conditions. The camera lucida is attached to the Microscope draw-tube by a collar with binding screw, so that the prism can be set at the proper distance from the eye-lens, as, without this adjustment, the camera lucida cannot be used with all eye-pieces.

Bausch and Lomb's Adjustable Drawing Board.*—The necessary inclination of the mirror of the Abbe camera lucida to the drawing

Fig. 108.

surface produces a constantly increasing elongation of the visual field when the drawing surface is parallel to the field of the Microscope, except when the mirror of the camera lucida is at 45°. It is, therefore, necessary to incline the drawing surface (fig. 108) in order to obtain accurate reproductions of any considerable size. The drawing board is vertically movable on a strong metal axis, to secure the same magnification on the paper as in the Microscope. The drawing plane is inclined by raising the right hand end of the board, a ratchet arm holding it firmly in any position. The angle of inclination is read off on the graduated arc. The Microscope is held in place by a clamp.

Davis, D. J. A.—**A Method of Microscopic Observation by means of Lateral Illumination.** *Trans. Chicago Pathol. Soc.*, vi. (1904) p. 98.

Dowdy, S. E.—**Attachable Object-finder.** *English Mechanic*, lxxix. (1904) p. 410

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* Catalogue A, 1904 (Microscopes and Accessory Apparatus) p. 70.

FEDOROW, E. v.—**Einige neue Hilsapparate für das polarisationsmikroskop.**
Ann. de Géol. et Minéral de Russie, iv. (1901) p. 142, and *Zeits. f. Kristallogr.*, xxxvii. (1903) p. 413.

GLEICHEN, A.—**Die Vergrösserung des Mikroskops unter Berucksichtigung der Refraktion und Akkommodation des Auges.** *Mechaniker*, xii. (1904) p. 135.

GRATTAROLA, G.—**Figure d'interferenza ottenute usando lastre spulite come analizzatore.** *Atti d. Soc. Tosc. d. Sci. Nat.*, xiv. (1905) pp. 164–71.

GREIL.—**Beleuchtungsapparate mit Nernstschem Glühlicht.**
Anat. Anz. Ergänzungsheft z., xxv. (Jena, 1904) p 178.

KALÄHNE, A.—**Über das Woodsche Lichtfilter für ultraviolette Strahlen.**
Phys. Zeits., v. (1904) p. 415.

PFLÜGER, A.—**Die Quecksilberlampe als ultraviolette Lichtquelle.**
Phys. Zeits., v. (1904) p. 414.

REGAUD, CL.—**Lampe électrique pour la Microscopie.**
Comptes Rend. Assoc. des Anatomes, Toulouse, 1904 ; *Bibliogr. Anatom. Supplém.* p. 203.

(4) Photomicrography.

Photomicrography with Ultra-violet Light.*—The equipment for this class of work has been described by A. Köhler and M. von Rohr, and is now obtainable from Carl Zeiss.† The results which, by the application of ultra-violet light to microscopical technique, are likely to be attained, are mainly—

1. That the resolving power of the objective is increased in the same proportion as the wave-length of the applied light is reduced. The apparatus presently described doubles the value of an objective of equal numerical aperture with daylight.

2. That numerous colourless organic objects exhibit considerable differences in their transparency, although in white light they show no colouring ; they behave, in regard to ultra-violet light, exactly as if they were objects diversely coloured.

3. That on living and defunct organic objects, ultra-violet light exerts, to some extent, marked physiological effects.

Photography is practically essential to the attainment of the first two objects ; but the results of the latter can be observed by white or coloured light and with ordinary achromats or apochrômats. For the ultra-violet rays the specially manufactured objectives used are termed monochromats. They have been designed by M. von Rohr, and are corrected for wave-length 275 $\mu\mu$ (0·000275 mm.). The N.A. of the strongest system is 1·25, while the resolving power, on account of the small wave-length of the light used, becomes equivalent to a N.A. of 2·5 with daylight. A table of this *relative resolving power* is supplied in C. Zeiss' catalogue. The lenses of the monochromats are manufactured out of molten quartz. Both the strongest systems are immersion lenses, while the immersion-fluid is a mixture of suitable refractive index, and is composed of chemically pure glycerin and distilled water. The cover-slip is also of molten quartz, and the object slides are formed from thin

* Zeitschr. f. Instrumentenk., xxiv. (1904) pp. 341–9 (6 figs.).

† Special Catalogue, Mikrophotographische Einrichtung für ultraviolettes Licht (wave-length 0·275 μ).

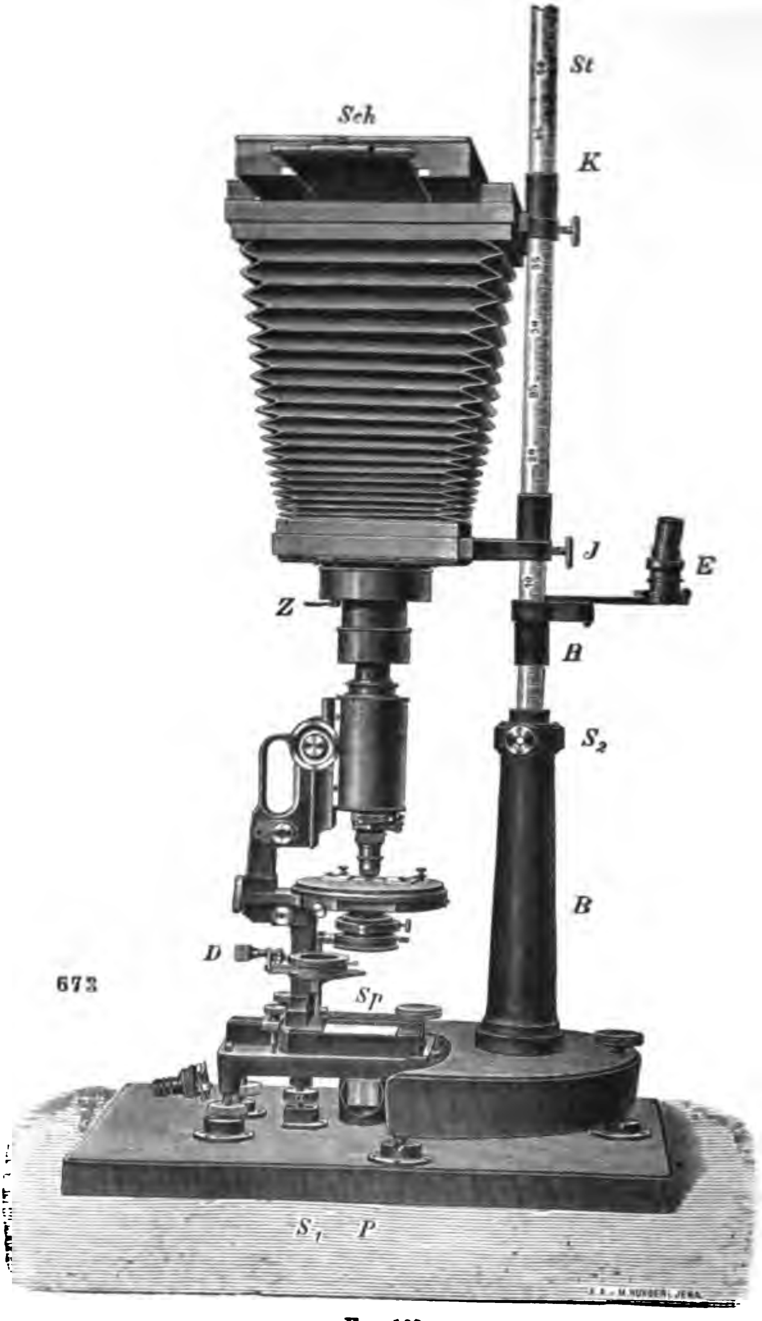

Fig. 109.

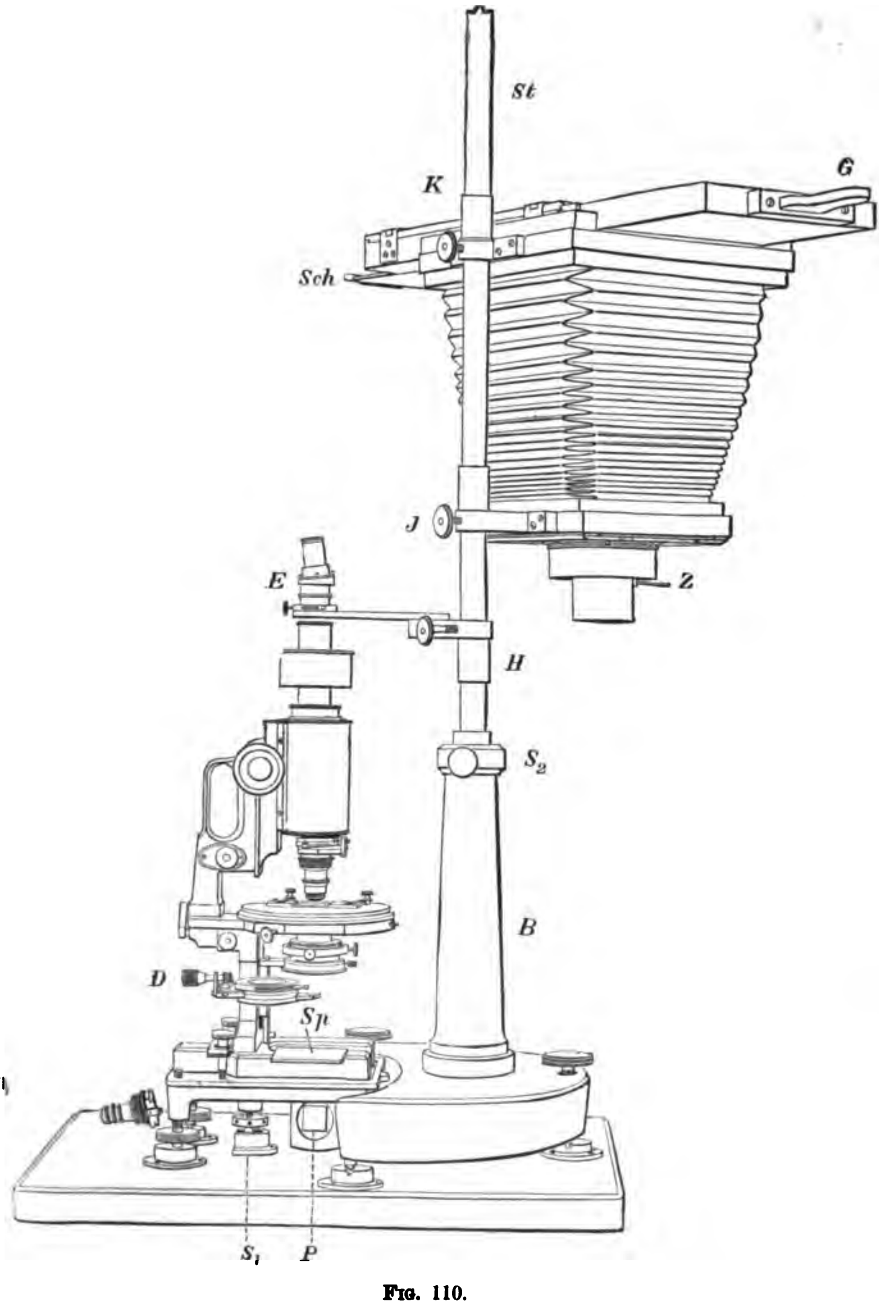

FIG. 110.

slips of rock-crystal or of ultra-violet transparent glass. The makers give warning that the monochromats cannot be used with daylight; and also that immersion-fluids of other composition, unless they have the same refractive index, cannot be used for ultra-violet photomicrography. For projection of the image on the photographic plate a special series of rock-crystal oculars has also been constructed. The ocular number gives, as in the case of the compensation oculars, the angular magnification.

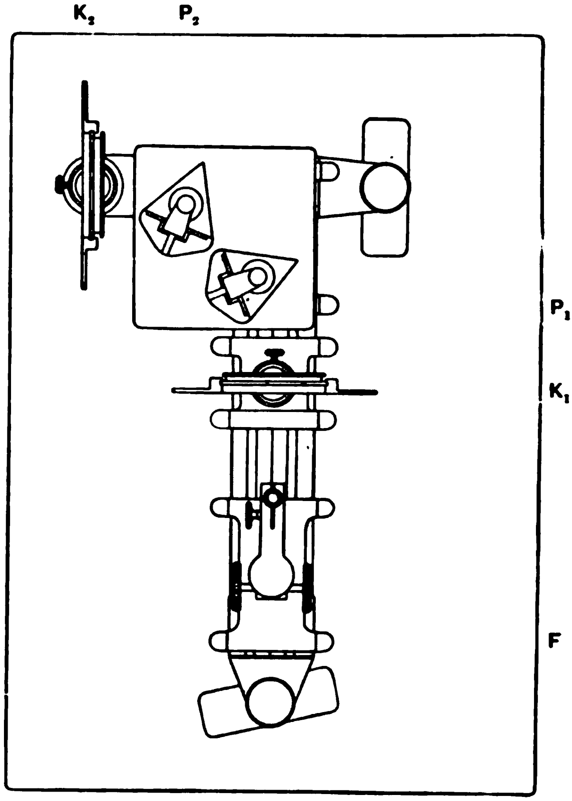

FIG. 111.

Zeiss' vertical camera is used as the photographic apparatus, because the perpendicular position offers various advantages over the horizontal. This is shown in fig. 109, about one-sixth of the full size. S_1 is the screw for firmly receiving the foot-plate for the Microscope; P is the rock-crystal reflexion prism, which reflects the horizontally incident light along the axis of the Microscope; S*p* is a plane mirror for observing the spark image on the uranium glass; D a diaphragm carrier with inserted uranium glass-plate swung aside. The upper arrangements are shown more clearly in fig. 110, which is also one-sixth of full size. B is the foot of the vertical camera; S_2 a clamp-screw for securing the rotatory graduated pillar S*t*; H the adjustable sleeve for the "finder"

(see below) E; J and K adjustable carriers for the camera; Z exposure shutter; *Sch* draw-off slide of the dark slide shutter; G handle of the frame for inserting the photographic plate. The "finder" is for personal observation and for adjustment, and is applied over the ocular of the Microscope. It is a specially constructed auxiliary, whereby the image can be thrown on to a fluorescent plate and observed through a strong loup. When the image is sharply defined on the fluorescent plate it will be also sharply defined on the photographic plate after the finder has been replaced by the camera. The plate must be set up 30 cm. from the ocular cap. Variations, not exceeding a few centimetres, of

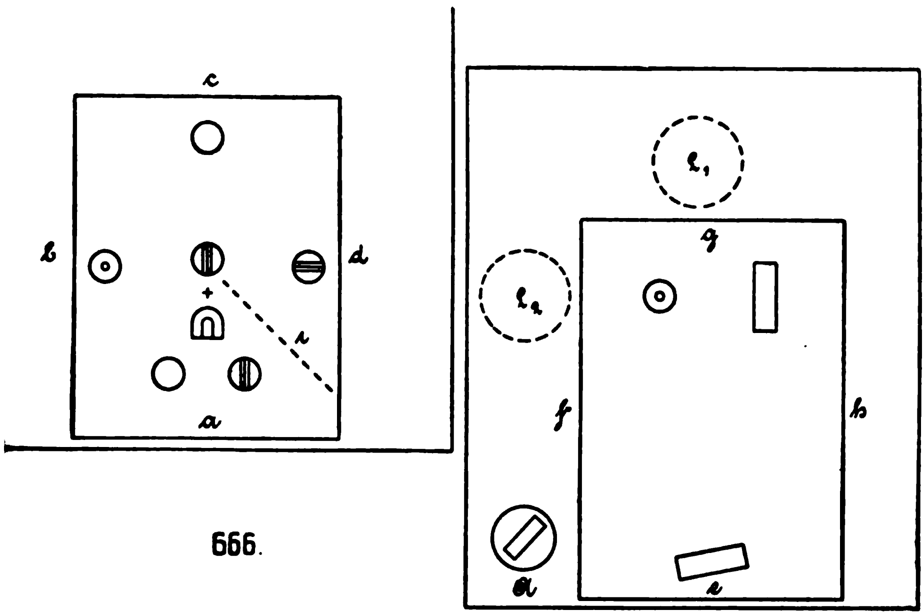

FIG. 112.

the camera-length do not much affect the sharpness of the image. The spark discharge between cadmium electrodes (in certain cases magnesium electrodes) of a Leyden jar, worked by an induction machine, serves as a light-source. The spark-length should be about 10 cm. The spark-light is led through a special illumination apparatus of rock-crystal lenses and prisms, and the light of wave-length 275 $\mu\mu$ (if of magnesium 280 $\mu\mu$) is separated off by an iris diaphragm. This diaphragm forms the entrance-pupil of a rock-crystal condenser, which takes the place of the ordinary glass condenser. The light then passes, as a cone of larger or smaller aperture, to the object. In fig. 111 there is shown the stage-plate with the illuminating apparatus, one-fifth full size. F is the spark-stand; K_1 the collimator; P_1 P_2 the rock-crystal prisms for conducting the rays of various wave-lengths from the light-source F; K_2 the collector, which gathers the rays of a certain wave-

length for a spark-image. The rays of selected wave-length emerging out of the collector then fall on the reflexion prism P, and are thereby conducted to the Microscope condenser. Fig. 112 (one-tenth full size) shows the installation of the entire apparatus; *a b c d* is the stage-plate for the Microscope and camera, with the slots for the position-screws of the foot-plate and the camera; it is set up on a table of ordinary height; *e f g h* is the stage-plate for the illuminating apparatus, with slots for its screws; it is set up on a table or cabinet 23 cm. lower than the above mentioned table. A lamp (e.g. an incandescent) is set up at L_1 or L_2 for examination of the object, with an achromat. If the lamp is placed at L_1 the rays are reflected at the last face of the prism P_2 laterally in the direction of the axis of the collector K, and reach the condenser of the Microscope after another reflexion at the prism P. If the lamp is placed at L_2 its rays fall direct on the prism P. This light must, of course, be removed when the ultra-violet light is used. A fluorescent screen *i* serves, on setting up the apparatus, to orientate in the spark-spectrum. Zeiss' catalogue gives full particulars of the lenses and all auxiliaries. A. Köhler,* who has both made a long series of investigations and has designed the apparatus, relates the history of his researches. He gives six plates, all of well-known objects, such as *Pleurosigma angulatum*, to illustrate his results.

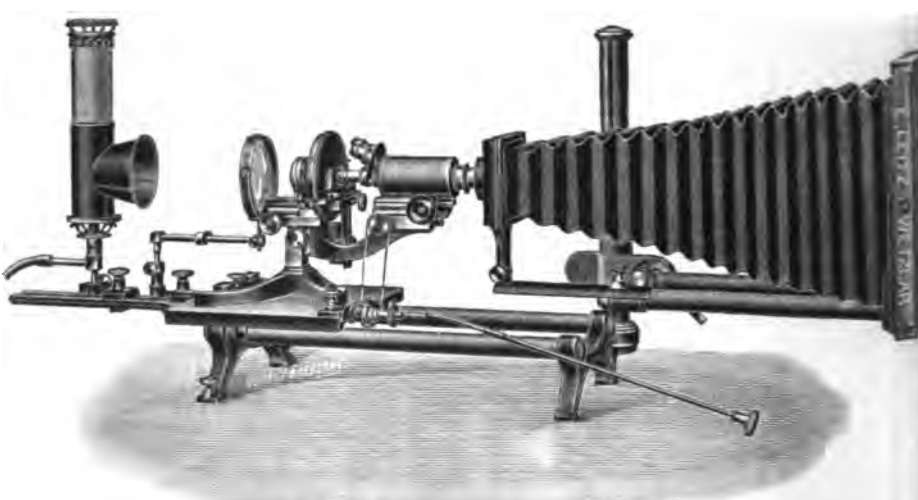

Fig. 113.

Leitz' "Universal" Microphotographic Apparatus.† — This is described by F. G. Kohl, but will now also be found in the latest

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 129-65, 273-304 (6 plates of photomicrographs). Also as a separate pamphlet, with title Mikrophotographische Untersuchungen mit Ultraviolettem Licht.

† Zeitschr. wiss. Mikrosk., xxi. (1905) pp. 305-13 (3 figs.).

catalogue* of the Leitz firm. It is shown in figs. 113–115. Fig. 114 shows the arrangement for vertical work. The base-frame rests on four feet, two of which are fitted with screws. A large foot-plate with push-movement on the two rails of the base carries the Microscope, and can be clamped when in position. A small bench is connected with the foot-plate, and carries an adjustable lens and a lamp with ground-glass disc. The camera is supported by pillars, and can be clamped at any desired height and inclination.

FIG. 114.

Fig. 113 shows the arrangement for horizontal work. In this position the maximum bellows extension can be attained—up to 500 mm.—with the help of a push-arrangement, on both ends of which the carrier of the camera collar can be clamped. A gearing is affixed to the large foot-plate for controlling the fine adjustment of the Microscope, by means of a cord operated by a pliable rod. For photographing transparent preparations up to 100 mm. diameter, with weak magnification, a small erect stage with diaphragms (fig. 115) can be clamped on to two sides of the large foot-plate so that it is at right angles to the camera axis.

* Catalogue No. 41 (1905) pp. 86–8.

The camera-neck is provided with a screw-thread on which, by means of an adapter ring, photographic objectives can be fixed. This arrangement also affords facilities for the application of Edinger's apparatus as well as for photographic purposes. For stereoscopic photography the erect stage is provided with a cross-slit so that the preparation can be pushed in two directions. Reflected light can be used with the vertically placed camera, and the foot-plate with the object is then pushed up to the ground-glass disc ready for the stereoscopic arrangement.

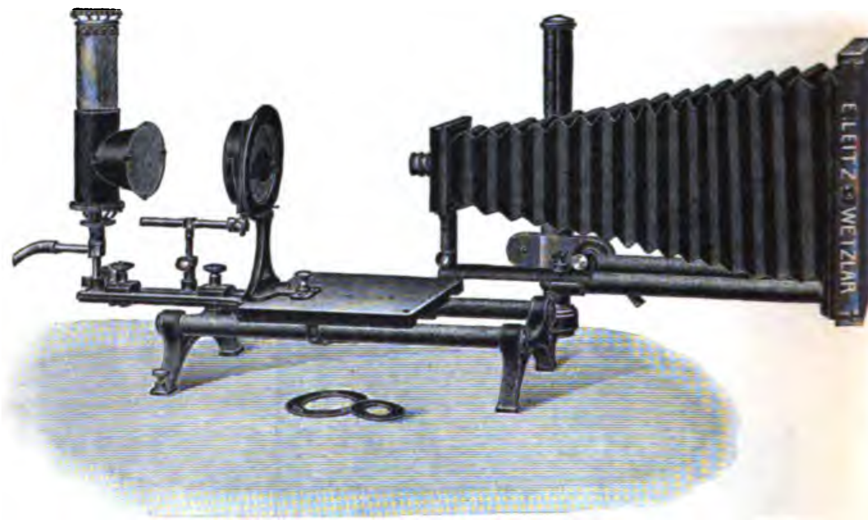

FIG. 115.

CROSBIE, F.—Directions for Photomicrography. *Lancet*, 1903, p. 233.

IVES, F. E.—Eine photomikrographische Vorrichtung. *Zeits. f. Opt. u. Mech.*, xxiv. (1903) p. 3.

" " Stereoscopic Photomicrography with high powers. *Trans. Amer. Micr. Soc.*, xxiv. (1902) p. 23.

LEISS, C.—Über eine neue Camera zur stereoskopischen Abbildung mikroskopischer und makroskopischer Objekte. *Zeitschr. f. Instrumentenk.*, xxiv. (1904) p. 61.

(5) Microscopical Optics and Manipulation.

Dark Field Illumination.*—C. Troester describes this method for the observation of living and unstained preparations of bacteria. It consists in showing a light object on a dark ground, and is obtained by shutting out the axial portion of the cone of light that comes from the condenser by means of a centrally placed screen, so that no direct light reaches the ocular. He obtains excellent results by allowing sunlight to pass through a spherical flask filled with water, and placed in the

* Centralbl. Bakt., 2te Abt., xiv. (1905) p. 511.

focus of a ground-glass plate; a short distance behind this plate is the Microscope that receives the light by means of a concave mirror. With this illumination 300 magnifications of living bacteria can be obtained with the same ease as with a good stained preparation.

Resolution of Grayson's Bands.*—A student, after detailing some resolutions of Grayson's bands, says: "The net results of these experiments show that on a bright ground a certain size of illuminating cone is required to develop the resolving power of any given objective, but an increase in the cone beyond that certain size is always accompanied by a falling off in resolving power. On a dark ground the case is somewhat different; with a ground just dark and no more, the highest resolving power of the lens is not developed, but all objects just short of the minimum resolvable are well seen. When light of greater obliquity is employed, the lens attains its maximum resolving power, but the resolution of objects well within its grip is impaired."

Doubling of Lines in the Abbe Experiments not due to the Diaphragms above the Objective.†—J. Rheinberg demonstrates this by using a single-aperture diaphragm, which he places in the upper focal plane. A coarse grating of about 100 lines to the inch (the widths of lines and spaces being equal) is placed on the object stage, and by giving a lateral movement of about $\frac{1}{16}$ inch to the diaphragm the effect of single and doubled lines is alternately produced.

Limit of Visibility of Isolated Elements in the Microscope.‡—K. Strehl makes some observations on this subject.

Bright Spots on a Dark Ground.—He regards the speculations of Siedentopf and Zsigmondy partly as hypothetical, partly as not free from objection, and therefore attaches more importance to their results as actually attained. With the most intense sunlight an illuminating system of N.A. 0·3, and an observation system of N.A. 1·2, and strong oculars, the least value they obtained for the edge of their cube-shaped gold particles was 4 $\mu\mu$ = 0·000004 mm.

Dark Spots on a Bright Ground.—On the basis of the diffraction theory, with N.A. 1·5, wave-length 500 $\mu\mu$, eye sensitiveness limit 5 p.c., and a completely aberration-free pencil, the author has demonstrated the following limits of visibility:

	Self-luminous.	Illuminated.
Smallest diameter of round dark apertures ..	48 $\mu\mu$	34·5 $\mu\mu$
Smallest breadth of straight dark slits	10·5 "	2·5 "

The comparison of both methods of observation is just as instructive as the results are important in the investigation after ultra-microscopic bacteria.

Achromatisation of Approximately Monochromatic Interference Fringes by a Highly Dispersive Medium, and the consequent Increase in the allowable Path-difference.§—R. W. Wood obtained

* English Mechanic, lxxxi. (1905) p. 339.
† Journ. Quekett Micr. Club (1905) p. 173 (2 figs.).
‡ Central. Zeit. f. Optik. u. Mech., xxvi. (1905) p. 117.
§ Proc. Amer. Acad. Arts and Sci., xl. No. 16 (1905) pp. 595-610 (3 figs.).

his results during the progress of an investigation of the dispersion of sodium vapour. He had previously found that the path-difference under which it is possible to obtain interference-fringes with helium (D_3) light can be more than doubled by the introduction of a small amount of sodium vapour into the path of one of the interfering beams. This development of fringes far out in the system by the dispersive action of the vapour is accompanied by their complete disappearance at the centre of the system, where the difference of path is zero. The author worked with a narrow range of the spectrum symmetrical about the D lines. This was obtained by opening the slit of the monochromatic illuminator, bisecting it with a wire, and adjusting the prisms so that the region of the D lines was screened off by the wire. By means of a small screen either of the two narrow portions of the spectrum bordering the D lines could be screened off. The effect of the sodium vapour on the fringes formed when the interferometer was illumined by either one or both of the two portions of the spectrum could then be studied at leisure. It was found that when a considerable amount of the vapour was present, the apparent centre of the greenish-yellow fringe system was widely separated from the centre of the orange-yellow system. When both sorts of light were used at once, there was a periodic visibility in the region in which the two systems overlapped.

CROOKES, SIR W.—**Ultra-Violet Spectrum of Radium.**
[The author has, with some exceptionally pure material, repeated the experiments of Runge, Demarçay, and Exner and Haschek. His results differ materially from theirs.] *Proc. Roy. Soc.*, lxxii., No. 482 pp. 295–304 (3 pls.).

" " **Ultra-Violet Spectrum of Gadolinium.**
[The author's experiments confirm those of Exner and Haschek, but do not seem to support Urbain's view that Gadolinium and Victorium are identical.] *Op. cit.*, lxxiv. No. 504, pp. 420-2.

FABRE, M. G.—**Les perfectionnements du Microscope.**
[The author gives an interesting resumé of recent investigations on ultra-microscopical bodies.] *Mém. de l'Acad. des Sci. de Toulouse*, Dixième Série, iv. (1904) pp. 314-20.

HAGA, H.—**Ein Vorlesungsversuch für die Bestimmung der Wellenlänge des Lichtes.** *Zeits. f. Unterricht.*, xvii. (1904) p. 283.

MARPMANN, G.—**Ueber ultramikroskopisches Sehen.**
[The author reviews our present knowledge of operating with ultra-violet rays.] *Zeits. f. ang. Mikr. u. Klinische Chemie*, xi. (April 1905) pp. 1-7

MERLIN, A. A. C. E.—**Amphipleura pellucida (Resolution of).** *English Mechanic*, lxxix. (1904) p. 284.

SCHIMMELPENNING, VON DER OYE, V.—**Zur Theorie du Doppelbrechung.** Teil i. (Brünn, 1903) 29 pp.

SCHUSTER, A.—**Introduction to Theory of Optics.** London (E. Arnold), 1904, 356 pp.

STONEY, JOHNSTONE, G.—**How to Exhibit in Optical Instruments the Resolution of Light into its component undulations of Flat Wavelets, and how to employ this resolution as our guide in making and in interpreting experiments.** *Rep. Brit. Assoc. Southport*, 1903 (1904) p. 563

TREADLE—**Amphipleura (Resolving).**	*English Mechanic*, lxxix. (1904) p. 68.
„ **Diatoms (Resolving).**	*Tom. cit.*, p. 84.
„ **Pinnularia nobilis (Resolution of).**	*Op. cit.*, lxxviii. (1904) p. 554; *Op. cit.*, lxxix. (1904) pp. 14, 35.
VILLAGIO—**Resolution of Diatoms, etc.**	*Tom. cit.*, p. 193.

(6) Miscellaneous.

Comparison of British and Foreign Students' Microscopes.*— "Paterfamilias," under the heading of "The Microscope and the Fiscal Question," thus compares the London-made Microscopes with those of foreign manufacture:

Foreign Microscopes.

Germany, Jena. In Zeiss' catalogue we find that the kind of instrument we require, i.e. one suitable for a student, is represented by Stand No. VI. A, and that its price is 12*l.* 10*s.* (The focusing of the substage condenser is by a sliding tube.)

America. Messrs. Bausch and Lomb supply an instrument very similar in every respect to the Zeiss for 11*l.* 6*s.*

Italy. Koristka, of Milan, supplies a Microscope precisely like the Zeiss for 10*l.* 16*s.*

Austria: Reichert, of Vienna. The Microscope of this maker differs from those preceding inasmuch as it has a lever interposed in the fine adjustment action, a sliding-bar to the main stage, screw focusing and centring action to the substage. Notwithstanding these accessories its price is 9*l.* 15*s.*, or 22 per cent. less than Zeiss.

Germany: Berlin. Messrs. Leitz supply a Microscope with a bent claw tripod foot and a sliding-tube focusing substage, but in other respects similar to the Zeiss Microscope, for 7*l.* 5*s.*, or 42 per cent. less than the Zeiss.

British Microscopes.

Messrs. C. Baker, of Holborn, quote a Microscope with a bent claw tripod foot, a differential screw fine adjustment, otherwise the same as the Zeiss, for 8*l.* 15*s.* 6*d.*

Messrs. Swift and Son, of Tottenham Court Road, supply a Microscope with a fine adjustment having an interposed lever, after the method of Reichert's, for 8*l.* 6*s.* In other respects it is the same as the Zeiss.

Messrs. Watson and Son, of Holborn, quote a "Fram" Microscope, having a tripod foot and a lever fine adjustment, for 8*l.* 8*s.*

These three Microscopes, of British manufacture, have a sliding-tube focusing substage at the price quoted.

Messrs. Beck and Co., of Cornhill, make a "London" Microscope with a screw focusing substage, otherwise similar to the Zeiss stand, for 7*l.* 11*s.*, or 40 per cent. less than the Zeiss.

In comparing the prices quoted by the various makers, we can see at once that in the foreign group of Microscopes the Jena, American and Italian are by far the most expensive, because they have the ordinary

* English Mechanic, lxxxi. (1905) pp. 290-1.

direct-acting screw fine adjustment, and a substage focusing by means of a sliding tube.

The Austrian is more expensive than the Berlin maker, but, on the other hand, he gives you more for your money. A lever is interposed in the fine adjustment, the substage has screw focusing as well as centring adjustments, and the main stage has a sliding bar.

In the English group, Baker, Swift and Watson all have a more complex fine adjustment than that of the ordinary Continental type; but they have only sliding-tube focusing arrangement to their substages. Beck's, on the other hand, retains the Continental form of fine adjustment, but adds the screw focusing adjustment to the substage, and that at a price lower than any similar class of Microscope of either British or foreign manufacture.

CZAPSKI, S.—**Grundzüge der Theorie der Optischen Instrumente nach Abbe.**
Leipzig: Joh. Ambros. Barth, 2nd edition, xvi. and 490 pp.

Die präzisionsmechanik und optik auf der Weltausstellung im St. Louis.
Deutsche Mechan.-Zeit., 1904, p. 181.

HAGER, H.—**Das Mikroskop und seine Anwendung.**
Berlin: J. Springer, 1904, 9th edition, 392 pp. (401 figs.).

NIEMANN, G.—**Das Mikroskop und seine Benutzung in pflanzenanatomischen Unterrichte.** *Magdeburg* (*Creutzsche Verlagsbuchhandlung*) 1904.

REINISCH, R.—**Petrographisches Praktikum. Zweiter Teil: Gesteine.**
Berlin, Gebru. Bornträger, 1904, vii. and 180 pp. (22 figs.).

RHEINBERG, J.—**The Collected Papers of Abbe and Microscope Theory in Germany.**
[The author has translated into English Dr. Ambronn's review (Zeit. f. wiss. Mikr., January 1905) of the collected papers of Professor Abbe, published last year.] *Journ. Quekett Micr. Club* (March 1905) pp. 153–66.

TREADLE—**British versus Foreign Microscopes.**
[Adversely criticises the heavy horseshoe foot and spring clips to stages. He advocates a sliding bar, and with regard to a tube fitting substage he says that "it is a great advantage if it screws, not into the stage itself, but into a flat ring screwed to the stage, the holes in the ring, through which the attaching screws pass, being quite loose to the screw shanks. Then the tube, with the condenser in place and focused, can be made to centre exactly, once for all, to, say, the $\frac{1}{6}$ objective, and made fast." He is of the opinion that a lever fine adjustment is very much superior to any direct-acting screw.] *English Mechanic*, lxxxi. (1905) pp. 312–13.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Spontaneous Action of Radio-active Bodies on Gelatin Media.† J. B. Burke calls attention to his interesting experiments on the action of radium salts on nutrient gelatin. In from 1–4 days there appears a culture-like growth, the nature of which is obscure. The bodies, as seen in the illustration, are round and possess a nucleus. They are soluble in water, and when they attain a certain size, subdivide. They disappear on heating and on exposure to sunlight, but reappear after a few

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Nature, lxxii. (1905) pp. 78–9 (3 figs.).

days. The first visible growth is on the surface of the medium, but in about a fortnight the substratum may be invaded to the depth of a centimetre. As the bodies are not microbic or crystalline in nature the author is disposed to regard them as colloid substances, and terms them radiobes in view of their resemblance to microbes and of their nature and origin.

(2) Preparing Objects.

Blood Spreader.*—This instrument, devised by M. J. Rosenau, is made by welding two pieces of solid glass rod together (figs. 116, 117).

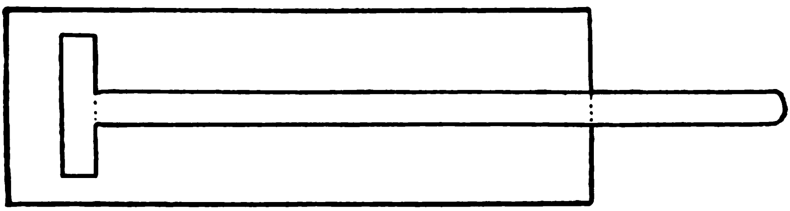

FIG. 116.

The short arm should be true so as to lie flat when applied to the slide, and should be several millimetres shorter than the width of the slide. A drop of blood is taken from the ear or finger-tip and placed upon one

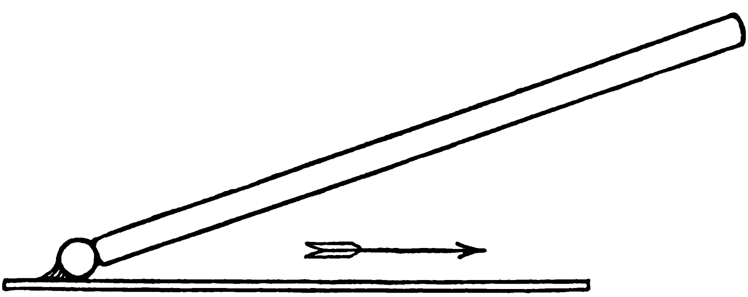

FIG. 117.

end of the slide in the usual manner. The spreader is then applied to the drop, and if the glass be clean the blood will at once be drawn by capillary attraction across its whole length; it is then stroked gently along the slide.

Preparing and Staining Eye of Honey Bee†.—For demonstrating the structure and development of the compound eye of the honey bee, E. F. Phillips proceeded as follows. Larvæ and pupæ were fixed in

* Yellow Fever Inst., Bull. 14 (Washington, 1905) pp. 52–3 (2 figs.).
† Proc. Acad. Nat. Sci. Philadelphia, lvii. (1905) p. 125.

Flemming's fluid, Hermann's fluid, picro-sulphuric, picro-acetic and picric acid saturated in 50 p.c. alcohol, but of these the Flemming and Hermann preparations yielded the best results. For the smaller larvæ it was not necessary to dissect before fixation, but for older lavæ and pupæ the head was removed to make penetration easier. For adult material, where penetration is difficult, the best fixative was acetic acid, generally a 10 or 20 p.c. acetic solution in 80–100 p.c. alcohol. Kleinenberg's picro-sulphuric and picric acid in 50 p.c. alcohol were also used, with fair results when the head was cut in two.

The material was all cut in paraffin, and it was found that for adult material long imbedding was necessary, 4–8 hours, to get the paraffin all through the tissues. Some material was imbedded for a shorter time to see whether the heat had produced any artefacts in the other material which was imbedded for the longer period, but in such cases the lens invariably separated from the retinular layer, no difference was observed in the internal tissues due to long heating. In staining, the best results were obtained in the use of Heidenhain's iron-hæmatoxylin, and by a strong mordant for a long time. For material of this kind there seems to be no better stain. It was found that by destaining to different degrees the various parts of the eye would show differences in colour, the rhabdome, for example, staining an intense black in rather deeply stained material. The nerve fibrils of the retinular cells also stained black with this stain. Other stains, such as Delafield's hæmatoxylin and eosin or Bordeaux red, were employed with very good results.

For depigmenting, Grenacher's solution with a somewhat greater percentage of acid was used. Parker's solution was also used, though the former gave better results.

Imbedding with Incomplete Dehydration.*—W. J. V. Osterhout gives the preference to a saponaceous medium for imbedding vegetable tissues over paraffin. He finds that cocoanut oil and sodium hydrate when mixed in the proportion of 70 c.cm. of oil to 38·5 c.cm. of 28 p.c. solution of caustic soda in water, makes an excellent basis. The oil is warmed in a water bath and the lye added gradually, the mass being stirred the while.

The tissue to be imbedded is warmed in a water bath and the soap added as long as it will dissolve. The whole is then poured into a suitable receptacle until sufficiently firm to cut into blocks. These blocks are treated after the paraffin method. Perfect sections 1 micron thick and several feet long are easily obtained. The sections may be treated in the usual way either by sticking them on slides or by immersing them in water and dissolving out the soap. But if they are to be fixed to slides in serial order, the ribands are placed on slides previously coated with white of egg and then dried; they are moistened with xylene, which makes them spread out and adhere. A piece of absorbent muslin is then pressed gently on the sections, and when the xylene has evaporated the muslin is moistened with water. The slide is then cautiously heated to coagulate the albumen and fix the sections to

* Univ. California Pub. Bot., ii. (1904) pp. 87–90.

the slide. The muslin is now moistened again, and afterwards carefully removed. The sections may now be treated in the usual manner.

Instead of water, alcohol may be used for imbedding. The tissue partly dehydrated is placed in alcohol on a water bath, and soap added till no more will dissolve.

Fixation in Vacuo.*—W. J. V. Osterhout describes a simple air-pump for removing air from vegetable tissues. The construction of the pump is seen in fig. 118. A piece of glass tubing 12–15 inches long is stopped at one end with sealing wax. A rubber disc (*r*) is pushed about an inch down the tube, and after carefully warming the glass, melted sealing wax is poured in. The piston may be prepared as follows: Insert a rubber stopper at the unsealed end of the tube, press it in gently and then cut it off cleanly just at the top of the tube. In the upper half of the stopper make another cut just above the first so as to slice off a disc about $\frac{1}{8}$ inch in thickness. With an awl make a hole exactly in the centre of this disc and force through it a brass rod about $\frac{3}{16}$ inch in diameter and of the form shown in the illustration. This should be provided with a thread at the end and carry a nut (*n*) above the disc and a nut and washer (*w*) below it. The washer should be a little smaller than the inside diameter of the tube.

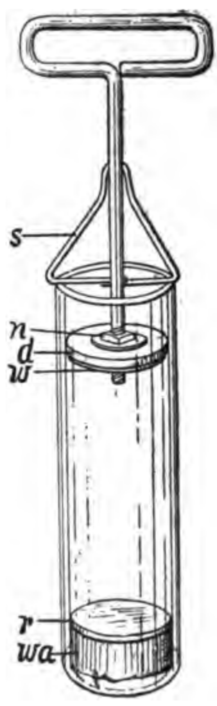

Fig. 118.

In order to use the apparatus the tissue is placed in the tube and the fixative poured over it. When the piston is pushed down the disc springs back to allow the air to escape. When it comes below the liquid it is pulled back, the result being the production of a very good vacuum. In order to inject tissues with fixative, the pieces are secured by means of wire or wedges so that they cannot rise in the liquid. The piston and the inner surface of the tube are then coated with vaselin to prevent the piston from sticking. The piston should be forced down about $\frac{1}{2}$ inch below the surface of the liquid and then drawn up again, when the springs (*s*) will hold it in place.

(3) Cutting, including Imbedding and Microtomes.

Agar-Agar and Paraffin Method for Imbedding Plant Tissues.†—H. H. York first kills the tissues, then imbeds in 2 and 5 p.c. agar solutions, afterwards imbedding in paraffin in the usual way. To the agar solutions 1 part of formalin to 9 parts by volume of agar is added. The tissues are placed in the 2 p.c. agar solution at 70° C. for two hours,

* Univ. California Pub. Bot., ii. (1904) pp. 78–80 (1 fig.).
† Ohio Naturalist, v. (1905) pp. 344–5.

and are then transferred to the 5 p.c. solution for one hour or more. In the 5 p.c. solution the tissues are blocked on bits of wood or glass plate, after which the blocks are passed through graded alcohols to paraffin. The layer of agar round the tissues is rendered very firm by the alcohol and prevents the material from being torn. The sections are very satisfactory.

If the material contain silicon it should be placed in water at 70° C. for an hour, and then in 10 p.c. hydrofluoric acid for 12 hours. On removal it is washed in water and treated as above.

Accessory for Freezing Microtomes.*—This invention of N. B. Harman consists of a box of thin metal, the walls of which are prolonged below the bottom of the box for the distance of a centimetre; the box is clothed in a jacket of felt. When sections are to be cut the chamber is filled with a mixture of ice and salt, and the box placed on the glass plate of the microtome, so that the specimen is enclosed in an atmosphere below freezing point. This device saves both time and ether.

Simple Freezing Microtome.†—W. J. V. Osterhout describes a microtome suitable for botanical purposes. It consists of an iron stand

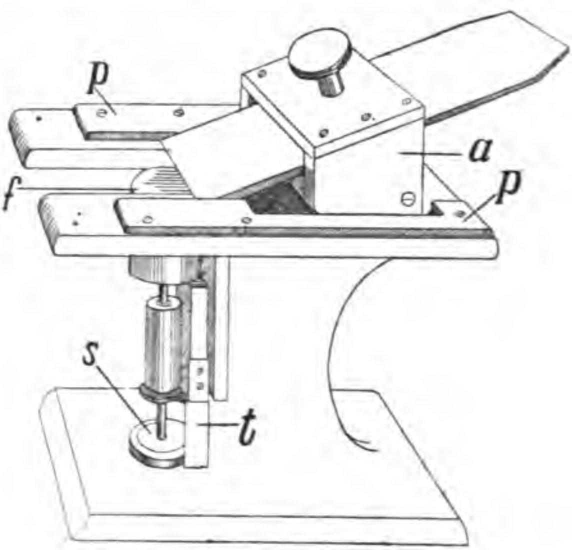

Fig. 119.

(fig. 119), which may be made from a piece of heavy T-rail about 8 in. long with a width of 4 in. at the top. At one end it is cut away so as to leave the two projecting arms, between which the freezing chamber *f* rests. This chamber is raised and lowered by means of the micrometer

* Lancet (1905) i. p. 1505, 1 fig.
† Univ. California Pub. Bot., ii. (1904) pp. 73–7 (2 figs.).

screw *s*. The knife is a carpenter's plane-iron, and this is fitted into the carrier *a*, which serves also for the purpose of sharpening on the hones. Two plates, *p p*, about $\frac{1}{16}$ in. thick, are fastened to the top in order to prevent the edge of the knife from coming in contact with the microtome. A small piece of tin *t* bent at right angles is so fastened that when its edge comes in contact with the milled head of the micrometer screw *s* it makes a clicking. The microtome works equally well with cold brine, carbon dioxide, ether, or rhizolene.

A sectional view of the attachment, which serves both as knife-carrier and handle for sharpening, is seen in fig. 120. It is made of brass or copper. The knife *k* is firmly held in place by means of the screw *s*,

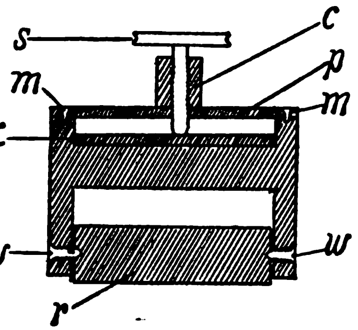

FIG. 120.

which passes through a collar *c* soldered to the top plate *p*, which in turn is fastened to the main body of the attachment by the screws *m m*. A cylindrical piece of brass *r* serves as a roller and turns on the screws *w w* as bearings. When the knife is placed for the first time on the hone the carrier is so adjusted by means of the screw that the ground surface lies flat on the hone. This position should be marked, so that when re-sharpening is required the same position may be readily attained. When placed in the microtome for cutting it is put $\frac{1}{4}$ to $\frac{1}{2}$ in. further back, so that its position is more vertical than when being sharpened.

(4) Staining and Injecting.

Staining the Tubercle Bacillus with Eosin.*—A. Mendoza states that the bacilli of tubercle, leprosy, smegma, and others can be stained by means of eosin. The preparations are treated for 24 hours in the cold, or heated for about 15 minutes. The fuchsin is made up with carbolic acid or an aldehyde of the aromatic series, to the action of which the author ascribes the penetrability of the staining solutions. When stained the preparations are decolorised with 10 p.c. acid alcohol.

Staining the Spirochætæ of Syphilis.†—E. J. McWeeney finds the spirochætæ of syphilis are negative to Gram, and that the results

* Bol. Inst. Alfonso xiii., 1 (1905) pp. 9–11.
† Brit. Med. Journ. (1905) i. pp. 1262–4 (1 fig.).

from carbol-fuchsin are poor. The best results were obtained with Giemsa's modification of the Romanowsky stain,* which imparted to the spirochætæ a distinctly reddish-violet tinge, while the bacteria came out blue. The films which were made from syphilitic sores and discharges were dried in the air, fixed for 10 minutes in absolute alcohol, and stained for some hours. The movements of the spirochætæ may be readily observed in hanging drops.

Affinity of Artificial Colouring Matters for Connective Tissue.†—Curtis and P. Lemoult record experiments which show that in order to develop the selectivity of connective tissue for certain pigments, it is necessary to work in presence of picric acid or some other tri-nitrite derivative, and moreover to use stains having at least three sulpho groupings (SO_3H) fixed in the chromogen and distributed as uniformly as possible. Satisfactory results are obtained from the use of acid fuschin, red-violet, 4 RS and 5 RS, which stain connective tissue red, or from Ponceau S extra, from diamine blue 2 B, or from naphthol black B, which stain respectively red or blue and possess the advantage of being fast.

Theory of Histological Staining.‡—G. Halphen and A. Riche, when studying the theory of histological staining, tested the action of dyes on sections of different animal tissues fixed by means of alcohol. The stain was dissolved in a thousand times its weight of water and used cold. After removing excess of stain with water the sections were dehydrated in a mixture of 1 volume absolute alcohol and 3 or 4 volumes of petroleum-ether. It was found that when slight quantities of acid were added to acid dyes their staining property was increased, and a similar effect resulted when basic dyes were treated with alkali. These results are referred to the basic and acid properties of the albuminoids. These properties are profoundly altered by the action of fixatives, such as formalin and Müller's fluid; so in order to prevent these influences the tissues to be experimented with were dried under bell-jars in the presence of glycerin or of sulphuric acid. Prepared in this way, the sections failed to show the presence of nuclei or cells of any sort, and the tissues were found to possess the property of energetically decomposing oxygenated water, a property which tissues preserved in alcohol do not possess.

Multiplex Slide-holding Device for Staining Sections.§—E. F. Miller describes an apparatus which consists of a series of perforated vulcanised rubber plates, placed in a holder, having a carrying capacity of 26 slides, so that they may be clamped against a metal plate by means of a thumb-screw. The principal advantages claimed for the apparatus are the saving of time and expenditure of reagents.

(5) Mounting, including Slides, Preservative Fluids, &c.

Imbedding Microscopic Algæ.‖—W. J. V. Osterhout remarks that the most serious difficulty in imbedding microscopic algæ lies in the fact

* J.R.M.S., 1905, p. 115.
† Comptes Rendus, cxl. (1905) pp. 1606–8. ‡ Tom. cit., pp. 1408–10.
§ Johns Hopkins Hosp. Bull., xvi. (1905) pp. 132–3 (1 fig.).
‖ Univ. California Pub. Bot., ii. (1904) pp. 85–6.

that they are usually mixed with dirt, which soon ruins the knife edge. This may be got rid of by rubbing them up gently in a considerable quantity of water and then decanting into a long tube, $\frac{1}{4}$ to $\frac{1}{2}$ in. in diameter, closed at the lower end with a piece of rubber tubing and a burette clamp. As soon as the dirt has settled to the bottom it may be drawn off. The tube may then be shaken up and the process repeated until no more dirt remains.

After being freed from dirt the algæ must be collected into a small space in order that they may be imbedded. The following method * has proved very successful for this purpose. A glass tube of about $\frac{1}{4}$ in. interior diameter is first smeared at the lower end with glycerin and then dipped into a solution of collodion or photoxylin. As soon as the collodion film has become firm it is pushed down a little so as to allow the end to be cut off with the scissors. An ordinary pipette bulb is now attached to the upper end and the lower end is again dipped in the collodion solution. As soon as it is withdrawn the bulb is compressed, with the result that a collodion bubble is blown at the lower end. The bulb is kept compressed until the bubble hardens into a firm sack. The pipette bulb is now removed and the tube is filled with the water containing the algæ. These gradually sink down into the collodion sack, which may then be compressed at the top with a pair of forceps while the water is poured off. Fixing fluid may then be poured into the tube and after an appropriate time got rid of in the same manner. The algæ may be washed with several changes of water, in the same manner, in order to remove the fixing fluid. The sack may now be held with the forceps as just described and cut off close to the bottom of the tube. The cut surfaces may then be brushed with a solution of collodion, which serves to seal the sack. It may then be dehydrated, together with the contained algæ, and imbedded in the usual way.

It often happens that the algæ remain suspended in the water and refuse to sink to the bottom even after some days. The addition of fixing fluid to the water often causes them to sink, but even this sometimes fails. In such cases the author has tried the expedient of adding a little white of egg, which soon coagulates, both in the water and in the fixing fluid, forming a flocculent precipitate which slowly settles, carrying the algæ down with it. Very obstinate cases may be treated by partly emptying the tube of water and cautiously pouring in alcohol of any desired grade. This gradually diffuses downward, and when the proportion of alcohol becomes great enough the algæ sink to the bottom.

In many cases it is possible to concentrate the algæ rapidly by simply filtering through the Schleicher and Schüll Filter paper No. 575, either with or without the use of a filter pump. This filter paper is hard and smooth, and the algæ, even when gelatinous, do not stick to it and can be washed down into a compact mass. Chamois skin may be used in the same way; in this case the filter pump is a necessity. The algæ cannot be washed down, but can be easily removed without the slightest injury (even in the case of swarm spores) by simply laying the wet chamois skin flat on a board and scraping with a knife. The knife must be pressed down firmly against the chamois skin so as to squeeze out the

* See also Strasburger's Practicum, 3rd ed., p. 366.

water (and the contained algæ) as it travels along, leaving the skin dry behind it. It will then be seen that the knife does not really come in contact with the algæ at all.

The collected algæ may be enclosed in a collodion sack as before or placed in a narrow vial and run up into paraffin by carefully decanting the successive liquids. When the paraffin is cooled the bottle is broken and the block cut in the usual way.

Rapid Method of Mounting in Aqueous Media.*—W. J. V. Osterhout has found the following method very successful. The examination is made in a drop of fluid placed on a cover-glass 1 in. square, and covered by a smaller one; both rest on an ordinary slide. Excess of fluid is removed so as to leave the margin of the larger cover-glass clean and dry. A drop of balsam dissolved in xylene is placed on another slide, and the cover-glasses placed thereon in an inverted position so as to bring the smaller one underneath. The arrangement is shown in section in fig. 121, *s* being the slide, *m* the material, *c c* the cover glasses,

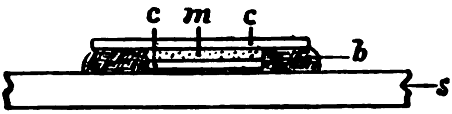

FIG. 121.

and *b* the balsam. The balsam must be quite fluid, and pressure and heat must be avoided. The preparation is then set aside to dry. Thick specimens, such as free-hand sections, may be treated as follows: They are placed on a slide in a drop of fluid, which is then surrounded by broken fragments of cover-glass. A large cover-glass is then imposed on these supports, the superfluous fluid is removed, and a drop of balsam run in. The zone of contact afterwards becomes cloudy, but this does not in any way detract from the value of the preparation.

Simple Slide-holder.†—W. J. V. Osterhout states that a very satisfactory holder for the simultaneous treatment of numerous slides can be made out of nickel or copper-plated steel wire. This is wound round a bar from ¼ to ½ the diameter desired for the coil, and should be hammered while still closely wound on the bar. As both sides of the coil are available, and as two slides placed back to back may be inserted in each space, it is obvious that a very large number, over a hundred, may be manipulated at the same time.

Modification of the Rousselet Live-box.‡—A. A. C. E. Merlin draws attention to the following modification of Rousselet's live-box. In order to retard evaporation the large cover-glass should be cemented to the carrier, instead of being held loosely in it by the screw arrangement, which is intended to facilitate the replacing of a fractured cover.

* Univ. California Pub. Bot., ii. (1904) pp. 83–4 (1 fig.).
† Tom. cit., pp. 81–2 (1 fig.).
‡ Journ. Quekett Micr. Club., ix. (1905) pp. 169–70 (1 fig.).

The carrier can easily be constructed with a broad flange to facilitate this, and in the event of breakage few would experience any difficulty in fixing another cover. In addition to the cemented cover-glass, it is only necessary that the carrier should accurately fit into the box in such a way that an elastic band may be placed round the rim over the line juncture, thus rendering the appliance practically airtight (fig. 122).

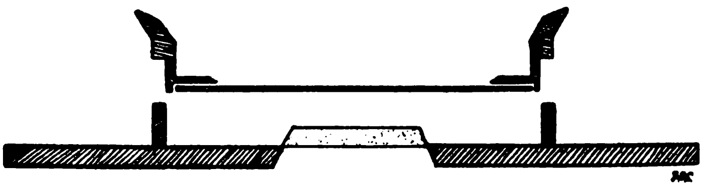

FIG. 122.

Method for Freeing Paraffin from Cedar-wood Oil.*—In the use of cedar-wood oil for imbedding tissues in paraffin it is a disadvantage that the oil is not volatile, and is thus retained in the paraffin, rendering it unfit for further use. W. Mair has found that by the following simple method a large part of the paraffin can be recovered in a tolerably pure condition. The contaminated paraffin is allowed to solidify at room temperature. It is then placed on top of a pledget of cotton-wool in a suitable vessel and allowed to remain in the incubator at body-temperature over-night. Next morning the wool will be found saturated with a melted mixture containing a great deal of oil and little paraffin, while the solid mass of paraffin above is fairly pure. This is removed and placed in the paraffin oven to filter, and the filtrate will be found quite satisfactory for at least the first paraffin bath.

Method for Preserving Bacterial Cultures for Class Purposes.†
E. S. G. Fowler writes: After subcultivating the purer colonies on fresh tubes and obtaining results which show the main features of particular growths, I pour on to the sloped or straight surface (streak and stab cultures) of the medium a covering some $\frac{1}{4}$ in. to $\frac{3}{8}$ in. deep of the following preparation: Gelatin, 50 grm.; formalin (40 p.c.) 20 minims; water (distilled), 1 fl. oz. The gelatin is dissolved in the water by heat, and when nearly cool the formalin is gently stirred in, so as to avoid air-bubble formation. Just before it sets it is poured over the growth to the depth required, and the plugs replaced and the tube left in position to cool. I next cut the wool plugs level with the tube mouth, and dip the plugged end into melting white wax and so seal them. The specimen is stored preferably in a cool, dark place. The preparation, being transparent, seems to serve the following purposes: (1) If the growth is not quite pure no further growth takes place after treatment, so that the specimen is fixed with features required; (2) no growth occurs from contamination, with ordinary care; (3) being transparent, it does not interfere with good viewing of the growth; (4) it checks

* Brit. Med. Journ. (1905) i. p. 1381. † Tom. cit., p. 1412.

drying of the medium for a considerable time; (5) there is little if any action on the specific colour of the growths on which I have tried it. Only one of my preparations is at all cracked, and not so as to affect the specimen. The others seem to have dried a little, but have quite a glassy surface.

Abel, R.—**Taschenbuch für dem bakteriologischen Praktikanten, enthaltend die wichtigsten technischen Detailverschriften zur bakteriologischen Laboroteriumsarbeit.** Würzburg: A. Stuber, 8th ed. (1904) vi. and 144 pp.

Besson, A.—**Technique microbiologique et sérothérapique.** Paris: Baillière et fils, 3rd. ed. (1904) 340 figs.

Forster, W. H. C.—**Simple Technique for the Enumeration of Organisms in any fluid.**
[A modification of the method of A. E. Wright for the estimation of the number of living organisms in a given culture, and also used for researches on blood serum, *Lancet* (1901) i. p. 1582.]
Lancet (1905) i. pp. 1641–2.

Ledermann, R.—**Die Mikroskopische Technik mit besonderer Berücksichtigung der Farbertechnik.** *Mod. Handbibliothek*,, Bd. vi., Wien and Leipzig, A. Hölder, 1903.

Prenant, A., Bouin, P., & Maillard, L.—**Traité d'histologie. I. Cytologie générale et spéciale.** Paris: C. Reinwald, Schleicher, frères et Cie. (1904) xxxiii. and 977 pp., 791 figs.

Röthig, P.—**Handbuch der embryologischen Technik.** Wiesbaden: J. F. Bergmann, 1904.

Stöhr, P.—**Traité technique d'histologie.** Paris: translated by H. Toupet and Critzmann, 3rd French ed., 514 pp., 399 figs.

Metallography, etc.

International Committee for Investigating the Constituents of Steel.*—The confused state of knowledge on the subject of the constituents of steel, and the want of agreement as to their number, characteristics, and modes of formation, have led, at the instance of R. T. Glazebrook and H. le Chatelier, to the selection of an international committee, which will undertake researches with the object of arriving at authoritative conclusions, and of drawing up a common system of nomenclature. The difficulties met with in the study of the constituents of steel are due to (1) the numerous allotropic states in which iron exists, (2) the fine state of division of the constituents, (3) the impossibility of separating by chemical means the different solid solutions present in quenched steels, owing to the similarity of their properties. The programme of preliminary researches proposed to be undertaken, to determine the conditions under which the various constituents are produced, is given. The co-operation of independent investigators will be welcomed.

Cobalt Steels.†—L. Guillet finds that the effect of cobalt upon iron, is, contrary to what has been supposed, altogether different to that of

* Rev. Metallurgie, ii. (1905) pp. 329–34. † Tom. cit., pp. 348–9.

nickel. Samples of steel containing up to 30 p.c. cobalt with 0·8 p.c. carbon, were examined and found to be pearlitic without exception. As the percentage of cobalt increases, the breaking load and elastic limit are gradually raised, with a corresponding reduction in elongation and contraction of area; no abrupt change in mechanical properties occurs. Cobalt steels have no industrial application.

Classification of Ternary Steels.* — L. Guillet recapitulates the results he has obtained in the course of his extensive investigations on alloys of iron and carbon with a third element, and draws some general conclusions. The method adopted was to examine, micrographically and mechanically, two series of alloys in each group, containing respectively 0·2 p.c. and 0·8 p.c. carbon, the percentage of the third element gradually being increased. The elements, the effects of which upon steel the author has thus demonstrated, are nickel, manganese, chromium, tungsten, molybdenum, vanadium, silicon, aluminium, cobalt, tin, and titanium. The steels are classified according to the results of microscopical examination as—(1) pearlitic; (2) martensitic; (3) containing γ iron; (4) containing a carbide; (5) containing graphite.

The influence of the third element upon the mechanical properties of the steel is shown in a series of curves, in which the abscissæ are percentages of the element, and the ordinates represent the differences between the properties of the alloy and those of carbon steel containing the same percentage of carbon. Diagrams of this kind are given for maximum tensile stress, elongation, and brittleness. The correspondence between micro-structure and mechanical properties is thus strikingly demonstrated. The author proposes to take up the investigation of quaternary alloys, such as nickel-manganese, nickel-chromium, and nickel-vanadium steel.

Metallography Applied to Foundry Work.† — In an article advocating the use of the Microscope in foundry work, A. Sauveur points out that the information as to the chemical composition and physical properties of metals obtained by an inspection of fractures, a method which has been universally employed in the foundry, may be largely supplemented by microscopical examination of polished and etched sections. Chemical analysis, again, while furnishing the ultimate composition of the metal, fails to suggest its proximate analysis; valuable information as to this proximate analysis may be obtained by the use of the Microscope. The author describes the methods which he has found to be most satisfactory for the preparation of the surfaces of sections.

Scientific Development of the Art of Polishing.‡—In the course of a lengthy article on this subject, F. Osmond and G. Cartaud show how the preparation of metallic surfaces for microscopical examination may affect the results obtained. The operation of polishing consists in the removal of metal from the surface, by means of a file, emery, or

* Rev. Metallurgie, ii. (1905) pp. 350–67 (13 figs.).
† Iron and Steel Mag., ix. (1905) pp. 547–53 (1 fig.).
‡ Rev. Gen. des Sci., xvi. (1905) pp. 51–65 (46 figs.). See also Eng. Mag., xxxix. (1905) pp. 261–3.

other abrasive, which produce a series of scratches. These scratches become finer and finer as the polishing proceeds, finer abrading materials being used until ultimately the marks are invisible. The formation of scratches on the metallic surface sets up internal stresses, so that the skin of the metal is in a different molecular condition from the interior of the mass. A strained surface film may thus result, which upon etching gives deceptive appearances not at all representing the structure of the mass. The authors state that by exercising care in polishing, these deceptive conditions may be almost entirely avoided.

Special Constituent Obtained by Quenching Aluminium Bronze.* P. Breuil has obtained some remarkable results when studying the effect of quenching on an aluminium bronze known as "Fortior." This alloy melts between 1010° and 1030° C., and shows a critical point between 690° and 730° C. Normally it is made up of large grains of copper or a copper-aluminium compound imbedded in a eutectic. By quenching at 650° C. and higher temperatures a constituent having a microstructure resembling that of martensite is obtained. The appearance of this martensitic constituent coincides with an increase in the elastic limit, maximum stress, and Brinell hardness number. Quenched at 850° C. the alloy is made up wholly of this constituent.

ANDERSON, W. C., & LEAN, G.—**Properties of the Aluminium-Tin Alloys.**
Proc. Roy. Soc., lxxii., No. 482, pp. 277–81 (2 figs. and 1 pl. of photomicros.)

BUFFET, E. P.—**Equipment and Work of Metallographical Laboratories in Germany.**
American Machinist, xxviii. (1905) pp. 348–9 (7 figs.).

GOLDSCHMIDT, H.—**Effect of Vanadium and Titanium on Steel.**
Electrochem. and Metallurgical Industry, iii. (1905) pp. 168–70.

GRADENWITZ, A.—**Methods of making Tests on Metals.**
[The machines devised by Guillery for determining hardness by the Brinell method, and for testing metals by impact on notched bars, are described.]
Iron and Steel Mag., ix. (1905) pp. 528–33 (4 figs.).

GUMLICH, E.—**Versuche mit Heuslerschen ferromagnetischen Mangan-Aluminium-Kupfer Legierungen.** *Electrotech. Zeitschr.*, ix. (1905) pp. 203–7 (7 figs.).

Impact Testing of Notched Bars. *Engineer*, xcix. (1905) pp. 249–50 (9 figs.).

KRYLOFF, DE—**Balance électro-magnétique pour l'essai des propriétés des aciers et des fers.** *Rev. Metallurgie*, ii. (1905) pp. 425–40 (11 figs.).

MALETTE, J.—**Special Steels.** *Rev. Technique*, xxvi. (1905) pp. 147–50.

MAHLER, P.—**Expériences sur la résistance électrique de l'acier.**
Rev. Metallurgie, ii. (1905) pp. 345–7.

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* Comptes Rendus, cxl. (1905) pp. 587–90.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 21ST OF JUNE, 1905, AT 20 HANOVER SQUARE, W., G. C. KAROP, ESQ., M.R.C.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 17th of May, 1905, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society voted to the donors.

	From
Braithwaite, R., British Moss Flora, pt. xxiii. (4to, London, 1905)	*The Author.*
Catalogue of Optical and General Scientific Instruments. (Optical Convention, 1905)	*Hon. Sec. of the Optical Convention.*
Pocket Botanical and Universal Microscope, by W. and S. Jones	*Mr. C. L. Curties.*
Wilson's Screw-barrel Microscope (probably by Adams) ..	*Ditto.*
Old Portable Microscope, by Shuttleworth	*Ditto.*

Mr. Rousselet described the three old Microscopes presented to the Society by Mr. C. L. Curties—one of which, by Shuttleworth, was of uncertain age, but probably dated from the beginning of the last century; another was a "Pocket Botanical and Universal Microscope" by W. and S. Jones, which was an improved form of one described by Adams in the first edition of his work on the Microscope; the third was an old Wilson Screw-barrel Microscope, made probably by Adams in 1746. These were all interesting examples of early Microscopes, and were welcome additions to the Society's collection. Figures and descriptions of these old Microscopes will appear in a subsequent number of the Journal.

The Chairman said they were greatly indebted to Mr. Curties for securing these old instruments and presenting them to the Society. In reference to one other donation, he thought they ought not only to thank Dr. Braithwaite, but also to congratulate him upon the completion of his monumental work on "The British Moss Flora," the final plate of which he understood was drawn on his 80th birthday.

Dr. Lazarus-Barlow exhibited and described a new form of warm stage which could be heated by gas or oil, and in which the regulation depended upon the expansion and contraction of a fixed volume of air. The water form of warm stage he had not found satisfactory. The method of regulation, which was by means of a mercury manometer and

a delicately poised balance, was indicated by a diagram drawn on the board. He at first tried a copper box to contain the air, but this did not answer owing to the critical expansion of the copper about the temperature of 100° F. which brought about a gradually rising temperature in the stage. He then successfully tried the effect of placing within the brass box forming the stage a number of glass bulbs as shown by a further diagram. Heat from the flame was conducted by means of a silver rod which dipped into a paraffin bath attached to the side of the stage itself. The entire arrangement was found to answer admirably, and an almost constant temperature could be maintained for a very considerable time.

Mr. Cecil R. C. Lyster also exhibited an improved form of electrical warm stage. He said that most of those previously made on this principle were heated by means of resistance coils, but he found that it was impossible to maintain an equable temperature in this way from the ordinary house current on account of its constant variations of intensity, for though it was nominally 100 volts it was not constant, sometimes rising to 103 and at others falling to 97, which caused considerable alterations in the temperature of the resistance coil. He had therefore endeavoured to find something which would obviate this inconvenience, and had found that by using Cryptol (A. Gallenkamp & Co.) as a resistance, a perfectly even temperature could be maintained as long as the current was passing. The amount of current consumed was extremely small, not exceeding 150 milliamperes, a quantity which was insufficient to work an electric meter, so that practically the arrangement could be worked for nothing. He regretted that he was unable to show the apparatus in action that evening, for although he had brought it to the meeting, he found that the current supplied to that building was 200 volts, whereas the resistance of the stage exhibited was only for 100.

On the motion of the Chairman a hearty vote of thanks was passed to Dr. Barlow and to Mr. Lyster for exhibiting and explaining these very ingenious and simple contrivances to the Society.

Mr. C. L. Curties exhibited an improved dark ground illuminator for high powers. He said he had received some time since an adapter from Messrs. Leitz, of Wetzlar, having a central dark stop for use near the back lens of one of their $\frac{1}{12}$ inch oil immersion objectives, and when this was employed with a special low-angle condenser, having rotating diaphragms and centring screws, making it suitable for Leitz' Microscopes, very good results were obtained. As, however, this adapter could only be used with objectives of Messrs. Leitz' manufacture, he had made an adapter with interchangeable stops fixed to pins, which were carried in the centre of the adapter, thus making it suitable for use with objectives of any make. He had found that when using an achromatic condenser of the ordinary type, stopped down a certain amount, all the results obtained by means of the special condenser were reproduced. He was showing *Pleurosigma angulatum* with this arrangement on a dark ground under a $\frac{1}{12}$ inch oil immersion objective

of ordinary make, and he thought the way in which the structure was resolved was quite satisfactory.

Mr. Rheinberg thought that the use of a black stop over the objective might, with a sufficiently strong source of light, prove more useful for indicating the presence of structure beyond the resolving power of the objective, on the lines of the Siedentopf methods, than for giving satisfactory images of detail which the objective was competent to resolve. Images obtained in this way were not very reliable, as objectionable diffraction effects were introduced by stopping out the central beam, and it was quite possible to get the structure duplicated. This applied specially to structures anywhere near the limit of resolution of the objective, when used in this manner. With *angulatum*, curiously enough, the dots were seen fairly well under the conditions in question, owing to the peculiar distribution of the spectra; but if other diatoms were tried the results would be more at variance with the correct image. He thought it would be better if, instead of stopping out the central light wholly with a black spot, they stopped out certain colours only; they would get contrast and at the same time be free from the objection mentioned. He had been led to examine the effects of black and coloured stops over the objective some years ago when experimenting on colour illumination, and had at the time referred to them in a paper read before the Society.*

Mr. Curties said he quite agreed with what Mr. Rheinberg said, as it was quite true that he could only resolve *angulatum* and *formosum* in this way; he was unable to do this with smaller diatoms he had tried, except so far as the coarse structure was concerned.

The thanks of the Meeting were voted to Mr. Curties for his exhibit.

Mr. Rheinberg called attention to an experiment in connection with the theory of Microscope images, which he had fitted up in the room, showing that the appearance of a grating could be produced in the field of the Microscope without there being anything on the stage. The lines seen were achromatic interference bands, produced with the help of two Thorp gratings of equal pitch placed behind the objective. A brief résumé of a paper on the subject recently read at the Optical Convention was given.

Mr. Rousselet called attention to an exhibit in the room of a living specimen of *Plumatella punctata* Hancock, sent by Mr. John Hood, of Dundee. This seemed to be a very rare fresh-water Polyzoon, which has not apparently been recorded in England since its first discovery by Hancock in 1850. It differs from *Pl. repens* and its varieties mainly by having a soft, gelatinous and transparent ectocyst, which spreads in rather stout branches horizontally on stones.

Mr. E. M. Nelson's paper on "The Tubercle Bacillus" was taken as read.

* "Notes on Colour Illumination, with special reference to the choice of suitable colours," J.R.M.S., 1899, pp. 143–4.

Mr. Conrady gave a résumé of his second paper on "Theories of Microscopical Vision," in which he applied to perforation-patterns and to crossed lines the principles laid down in his first paper on the subject, his aim being to show that the gradual improvement of images with increasing aperture could be fully accounted for by the Abbe theory. He also claimed that the employment of wide "aplanatic" cones of illumination was amply justified by this theory, because, on the one hand, it protected the observer against spurious images due to a defective objective or bad adjustments, simply because only a perfectly adjusted instrument would bear a wide cone; whilst, on the other hand, the wide cone gave the full resolving power of the instrument *in all directions*, thus disclosing at one glance all that a given instrument could show.

He also adduced experimental evidence which would seem to disprove the spurious disk theory, whilst upholding the diffraction theory. Experiments illustrating this were shown under Microscopes in the room.

In moving a vote of thanks to Mr. Conrady, the Chairman said the Society was greatly indebted to him for his papers on this subject, which, to be fully appreciated, must of course be read.

An exhibition was then given of a number of lantern slides prepared by Mr. Flatters from plates illustrating beautiful microscopic objects from amongst the Radiolaria, Foraminifera, Infusoria, Desmids, etc. Some extremely fine lantern photographs of corals, from Mr. W. S. Kent's work on the Great Barrier Reef of Australia, were deservedly admired, and the thanks of the Society were heartily accorded to Mr. Flatters for the opportunity afforded to the Fellows of seeing these excellent reproductions.

Notice was given that the rooms of the Society would be closed on and from August 14th to September 11th.

The following Instruments, Objects, etc., were exhibited :—

The Society :—Pocket Botanical and Universal Microscope, by W. & S. Jones ; a Wilson's Screw-barrel Microscope, probably by Adams ; an Old Portable Microscope, by Shuttleworth ; Lantern Slides, mostly zoological, lent for the occasion by Mr. Flatters.

Mr. A. E. Conrady :—*Pleurosigma angulatum*, just resolved with N.A. 0·55 and a full cone of illumination ; ditto, with ½ in. objective, N.A. 0·65, having spherical aberration, the broken edge focussing at a different level compared with the structure ; diffraction spectra, with curved wave-fronts (no change whatever takes place on racking the condenser up and down, although the wave-fronts change from concave to convex) ; diagrams shown on the screen in illustration of his paper.

Mr. C. L. Curties :—Apparatus for obtaining dark-ground illumination with high powers.

Dr. W. S. Lazarus-Barlow :—A warm stage, heated by gas or oil flame.

Mr. Cecil R. C. Lyster :—An electrically heated warm stage.

Mr. Rheinberg :—The production of achromatic interference fringes.

Mr. Rousselet :—*Plumatella punctata*, received from Mr. John Hood.

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OF

THE ROYAL MICROSCOPICAL SOCIETY.

ELECTED 18th JANUARY, 1905.

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ROYAL MICROSCOPICAL SOCIETY.

MEETINGS FOR THE SESSION 1904—1905

AT 8 P.M.

Wednesday, Oct. 19, 1904
„ Nov. 16, „
„ Dec. 21, „
„ Jan. 18, 1905 *(Annual Meeting for Election of Council and Officers.)*
Wednesday, Feb. 15, 1905
„ Mar. 15, „
„ Apr. 19, „
„ May 17, „
„ June 21, „

Fellows intending to exhibit any Instruments or Objects, or to bring forward any Communications at the Ordinary Meetings, will much facilitate the arrangement of the business thereat if they will inform the Secretaries of their intention two clear days at least before the Meeting.

Air (n = 1·00).	Water (n = 1·33).	Homogeneous Immersion (n = 1·52).	White Light. (λ = 0·5607 μ) Between D and E.	Monochromatic (Blue) Light. (λ = 0·4861 μ. Line F.)	Photography. (λ = 0·4000 μ. Near Line h.)	Power. (a^2.)	[illegible]
..	..	180° 0'	137,672	158,845	193,037	2·310	[illegible]
..	..	168° 51'	136,766	157,800	191,767	2·280	[illegible]
..	..	161° 23'	135,860	156,755	190,497	2·250	[illegible]
..	..	157° 12'	134,955	155,710	189,227	2·220	[illegible]
..	..	153° 39'	134,049	154,665	187,957	2·190	[illegible]
..	..	150° 32'	133,143	153,620	186,687	2·161	[illegible]
..	..	147° 42'	132,237	152,575	185,417	2·132	[illegible]
..	..	145° 6'	131,332	151,530	184,147	2·103	[illegible]
..	..	142° 39'	130,426	150,485	182,877	2·074	[illegible]
..	..	140° 22'	129,520	149,440	181,607	2·045	[illegible]
..	..	138° 12'	128,614	148,395	180,337	2·016	[illegible]
..	..	136° 8'	127,709	147,350	179,067	1·988	[illegible]
..	..	134° 10'	126,803	146,305	177,797	1·960	[illegible]
..	..	132° 16'	125,897	145,260	176,527	1·932	[illegible]
..	..	130° 26'	124,991	144,215	175,257	1·904	[illegible]
..	..	128° 40'	124,086	143,170	173,987	1·877	[illegible]
..	..	126° 58'	123,180	142,125	172,717	1·850	[illegible]
..	..	125° 18'	122,274	141,080	171,447	1·823	[illegible]
..	..	123° 40'	121,369	140,035	170,177	1·796	[illegible]
..	180° 0'	122° 6'	120,463	138,989	168,907	1·769	[illegible]
..	165° 56'	120° 33'	119,557	137,944	167,637	1·742	[illegible]
..	155° 38'	117° 35'	117,746	135,854	165,097	1·690	[illegible]
..	148° 42'	114° 44'	115,934	133,764	162,557	1·638	[illegible]
..	142° 39'	111° 59'	114,123	131,674	160,017	1·588	[illegible]
..	137° 36'	109° 20'	112,311	129,584	157,477	1·538	[illegible]
..	133° 4'	106° 45'	110,500	127,494	154,937	1·488	[illegible]
..	128° 55'	104° 15'	108,688	125,404	152,397	1·440	[illegible]
..	125° 3'	101° 50'	106,877	123,314	149,857	1·392	[illegible]
..	121° 26'	99° 29'	105,065	121,224	147,317	1·346	[illegible]
..	118° 0'	97° 11'	103,254	119,134	144,777	1·300	[illegible]
..	114° 44'	94° 55'	101,442	117,044	142,237	1·254	[illegible]
..	111° 36'	92° 43'	99,631	114,954	139,698	1·210	[illegible]
..	108° 36'	90° 34'	97,819	112,864	137,158	1·166	[illegible]
..	105° 42'	88° 27'	96,008	110,774	134,618	1·124	[illegible]
..	102° 53'	86° 21'	94,196	108,684	132,078	1·082	[illegible]
..	100° 10'	84° 18'	92,385	106,593	129,538	1·040	[illegible]
180° 0'	97° 31'	82° 17'	90,574	104,503	126,998	1·000	[illegible]
157° 2'	94° 56'	80° 17'	88,762	102,413	124,458	·960	[illegible]
147° 29'	92° 24'	78° 20'	86,951	100,323	121,918	·922	[illegible]
140° 6'	89° 56'	76° 24'	85,139	98,223	119,378	·884	[illegible]
133° 51'	87° 32'	74° 30'	83,328	96,143	116,838	·846	[illegible]
128° 19'	85° 10'	72° 36'	81,516	94,053	114,298	·810	1·111
123° 17'	82° 51'	70° 44'	79,705	91,963	111,758	·774	[illegible]
118° 38'	80° 34'	68° 54'	77,893	89,873	109,218	·740	[illegible]
114° 17'	78° 20'	67° 6'	76,082	87,783	106,678	·706	[illegible]
110° 10'	76° 8'	65° 18'	74,270	85,693	104,138	·672	[illegible]
106° 16'	73° 58'	63° 31'	72,459	83,603	101,598	·640	[illegible]
102° 31'	71° 49'	61° 45'	70,647	81,513	99,058	·608	[illegible]
98° 56'	69° 42'	60° 0'	68,836	79,423	96,518	·578	1·316
95° 28'	67° 37'	58° 16'	67,024	77,333	93,979	·548	1·351
92° 6'	65° 32'	56° 32'	65,213	75,242	91,439	·518	[illegible]
88° 51'	63° 31'	54° 50'	63,401	73,152	88,899	·490	[illegible]
85° 41'	61° 30'	53° 9'	61,590	71,062	86,359	·462	1·471
82° 36'	59° 30'	51° 28'	59,779	68,972	83,819	·436	1·515
79° 36'	57° 31'	49° 48'	57,967	66,882	81,279	·410	[illegible]
76° 38'	55° 34'	48° 9'	56,156	64,792	78,739	·384	1·613
73° 44'	53° 38'	46° 30'	54,344	62,702	76,199	·360	[illegible]
70° 54'	51° 42'	44° 51'	52,533	60,612	73,659	·336	[illegible]
68° 6'	49° 48'	43° 14'	50,721	58,522	71,119	·314	[illegible]
65° 22'	47° 54'	41° 37'	48,910	56,432	68,579	·292	[illegible]
62° 40'	46° 2'	40° 0'	47,098	54,342	66,039	·270	[illegible]
60° 0'	44° 10'	38° 24'	45,287	52,252	63,499	·250	2·000
53° 30'	39° 33'	34° 27'	40,758	47,026	57,149	·203	[illegible]
47° 9'	35° 0'	30° 31'	36,229	41,801	50,799	·160	2·500
40° 58'	30° 30'	26° 38'	31,701	36,576	44,449	·123	[illegible]
34° 56'	26° 4'	22° 46'	27,172	31,351	38,099	·090	3·333
28° 58'	21° 40'	18° 56'	22,643	26,126	31,749	·063	4·000
25° 4'	17° 18'	15° 7'	18,115	20,901	25,400	·040	5·000
	12° 58'	11° 19'	13,586	15,676	19,050	·023	6·667
	[illegible]° 38'	7° 34'	9,057	10,450	12,700	·010	10·000
	[illegible] 18'	3° 46'	4,529	5,252	6,350	·003	20·000

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VI.—*Theories of Microscopical Vision.*

(Second Paper.)

By A. E. Conrady, F.R.A.S., F.R.M.S.

(*Read June 21st,* 1905.)

In a former paper* I endeavoured to show that the explanation of microscopical images must always be sought on the basis of Professor Abbe's theory; in other words, that the detail is brought out by the light diffracted by the object. I further showed how the formation of the image of a simple plane grating could be fully accounted for on the basis of Abbe's theory, and that the objections which have at different times been raised against that theory are unsound.

In establishing these results I introduced two essentially new propositions, the first referring to certain interesting differences of phase between different spectra from any one grating, the second serving to explain how the want of definite focus in an elementary diffraction-image is replaced by the much desired well defined focus under the usual working conditions.

I now proceed to the consideration of more complicated structures—dot and cross-lined patterns—on the same basis.

It will be remembered that it is with such patterns that the most startling false images are secured in the experiments with the "Diffraction-plate"; it will therefore be extremely interesting to study the images obtainable with such gratings under "normal working conditions," i. e. when the simple circular form of the aperture of the object-glass is not interfered with.

* J.R.M.S., 1904, p. 610–633.

Our first step must be to determine the diffraction-spectra produced by such structures. We know that a grating of simple, straight, and narrow slits like fig. 123 gives a row of diffraction-spectra lying at right angles to the direction of the slits. Supposing we place another simple grating across this one in the manner shown in fig. 124, the result will be that the light from those parts of each original slit which are covered by the bars of the second grating is cut off; but the light from the portions of the original slits which remain uncovered necessarily continues in the same phase-relation as before, and therefore produces precisely the same row of spectra, only proportionately weakened in brightness. Hence a row of bright dots produces essentially the same diffraction-spectra as the unbroken slit, of which the dots may be considered to be intermittent portions. But this deduction immediately leads us to another; for if the dots are arranged in any perfectly regular order, they will range themselves into straight rows in a number of different ways and directions, and thus we are justified in laying it down that a dot-pattern produces rows of diffraction-spectra corresponding to all simple line-gratings, the slits of which have a direction in which the dots form themselves into straight rows. We will study two concrete cases to make this abstract proposition clearer. Let us first take bright spots (or perforations) arranged in perfect squares (fig. 125). We can range these—

1. Into horizontal rows *a*, *a*..., corresponding to a vertical row of diffraction-spectra A_1, A_2, etc., in fig. 125A.

2. Into vertical rows *b*, *b*..., corresponding to a horizontal row of diffraction-spectra B_1, B_2, etc., in fig. 125A.

3. Into two oblique rows, *c*, *c* and *d*, *d*..., with corresponding rows C_1, C_2..., D_1, D_2..., of diffraction-spectra; and we note that the lines *c*, *c* and *d*, *d* are closer together, hence the corresponding diffraction-spectra are further apart.

4. We can arrange those dots into rows which are in the relation of a knight's move on a chessboard—with four possible directions *e*, *f*, *g* and *h*; the distance between these rows will be still smaller than that found in case (3), and the diffraction-spectra E, F, G, H, will be correspondingly further apart.

Evidently this may be carried further and further; the principle will, however, now be perfectly clear.

The result is that the dot pattern here considered gives a set of diffraction-spectra precisely similar in arrangement to the pattern itself; for a simple mathematical investigation shows that the increasing closeness of the oblique rows of successive orders is such as to cause the corresponding diffraction-spectra to be spread out to the proper distances to cover the right places in our pattern.

It should be pointed out that both fig. 125 and fig. 126 show the dots black instead of white, after the manner of a photographic negative.

The second case to which we will pay attention will be a dot-pattern arranged in equilateral triangles, as shown in fig. 126. Similar reasoning to that just applied to the square pattern shows us three directions, *a*, *b*, *c*, in which the dots arrange themselves into rows with a maximum distance apart; next three directions, *d*, *e*, *f*, of closer rows of dots; and so on, the result being again that a set of diffraction-spectra, as illustrated in fig. 126A, is formed similar in arrangement to the pattern itself.

The reasoning here used is *directly* applicable only to very small perforations which can be considered as parts of *separate* and distinct lines, *a*, *b*, *c*, *d*, etc. But as the diffraction-spectra are

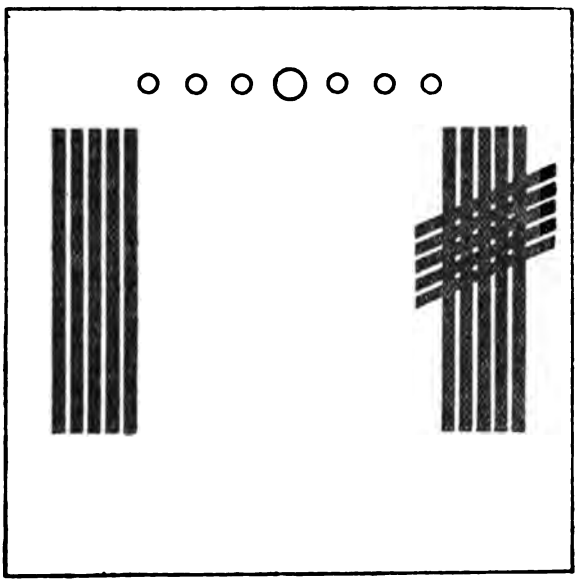


Fig. 123. Fig. 124.

formed by light from all the perforations meeting with differences of phase expressed by a *whole* number of wave-lengths, and as *this* phase-relation will not be disturbed if all the perforations are *uniformly* increased in size, it will be seen that the *arrangement* of the diffraction-spectra must remain the same no matter how large the perforation may become; for that arrangement is determined by the configuration of similarly situated points in the individual perforations.

The relative brightness of, and the phase-relation between the direct light and the different spectra will, however, depend upon the relative size and upon the shape of the dots or perforations;

this, therefore, remains to be investigated in each individual case, and will have to be attacked by applying the Huyghenian principle in the same manner in which I applied it to simple gratings in my first paper.

Before proceeding to this we must, however, study another class of gratings, viz., those consisting of bright line-patterns, or of opaque dots. At first sight this looks a more formidable problem than that of the perforation-patterns, but it can be dealt with at once by the application of Babinet's theorem concerning "reciprocal gratings." Two gratings are said to be reciprocal when the

Fig. 125.

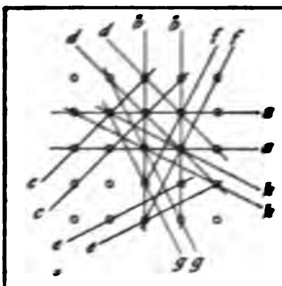
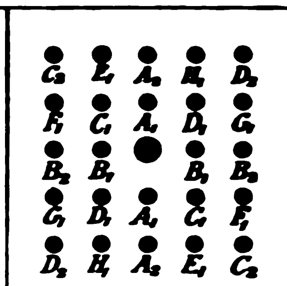


Fig. 125a.



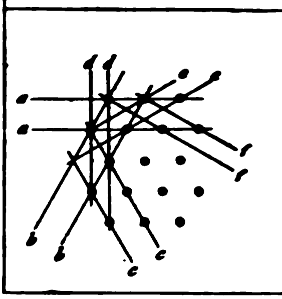


Fig. 126.

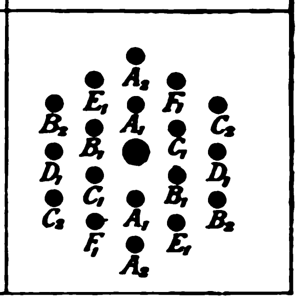


Fig. 126a.

opaque portions of one are precisely similar to the transparent portions of the other, and when it is therefore *just possible* to so superpose one upon the other as to produce uniform opacity. In other words, a grating and its reciprocal stand in the exact relation to each other of a photographic negative and the corresponding positive transparency.

The simple process of reasoning first applied by Babinet then leads to the discovery of a very simple and valuable relation between the diffraction-spectra from reciprocal gratings.

Supposing we have an aperture fitted with two screens in such a manner that either one or both together may be applied or removed, screen No. 1 having perforations of any shape and design

whatever, whilst screen No. 2 is so cut and adjusted that when superposed it exactly covers the apertures in No. 1. Therefore, if we apply screen No. 1 by itself we shall have the set of apertures cut in it; if we apply screen No. 2 by itself we shall have a new set of apertures corresponding precisely to the dark portions of screen No. 1; screen No. 2 therefore represents a grating reciprocal to that formed on screen No. 1.

The apertures in screen No. 1 will produce a set of diffraction-spectra peculiar to their shape and configuration; the apertures in screen No. 2 will also produce a set of diffraction-spectra. If now we let both sets of apertures act at the same time, we are justified by the Huyghenian principle in stating that the diffraction-effects of both sets are now superposed. But the uncovering of both sets of apertures means the removal of both our screens with the consequent exposure of a simple large aperture producing no sensible diffraction-effect; in other words, we are driven to the conclusion that the diffraction-spectra produced by the apertures in screen No. 2 exactly blot out or neutralise those produced by the reciprocal screen No. 1. According to the undulatory theory, this can only be explained on the assumption that the light diffracted by screen No. 2 is precisely equal in intensity, but also exactly opposed in phase to the light diffracted by the reciprocal screen or grating, which we designated as No. 1.

This, then, is Babinet's theorem; it states that reciprocal gratings produce diffraction-spectra in the same directions and of the same intensities, but opposed to each other—*cæteris paribus*—in phase.

It will be seen that this convenient theorem enables us to determine the complete diffraction-pattern produced by any bright line device by first ascertaining that of a perforation pattern having perforations exactly corresponding to the opaque dots of the bright line device, and then attributing to the latter diffraction-spectra of the same distribution and intensity, but of the opposite phase when referred to some definite point of reference such as the centre of the dots. Babinet's theorem does not, however, give us any direct information about the intensity of the *direct* light; this, therefore, remains to be determined in each individual case.

Having learned how the diffraction produced by the complicated structures now under consideration may be completely determined, we are in a position to discuss the image resulting from the co-operation of a greater or lesser number of the diffraction-spectra in the field of a Microscope directed and focused upon such structures.

We will first take a pattern consisting of relatively small perforations arranged in perfect squares such as we have represented (as a *negative*) in fig. 125. Owing to the smallness of the dots, they may be considered as intermittent portions of relatively narrow slits, and, in accordance with the reasoning given in my

former paper, we may safely assume that all the spectra immediately surrounding the direct light will leave the centres of the dots in exact phase with the direct light, and will, in accordance with the fundamental principle of the equality of optical paths, arrive in the same phase-relation at the centres of the ideal geometrical images of the dots. Hence we see that in this case also, in precise analogy to what I proved to be the case with simple line-gratings, the centres of the bright dots must be represented in the image by maxima of brightness exactly coinciding with the geometrical images of the dots, and that the position of the latter will, therefore, be correctly indicated.

Fig. 127A. Fig. 127B.

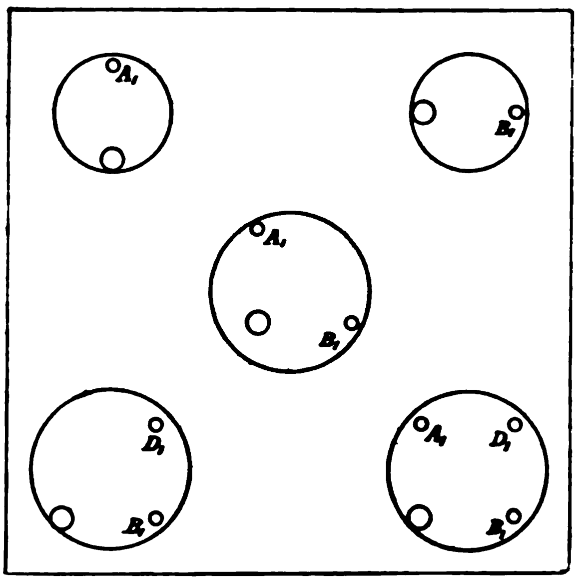


Fig. 127C.

Fig. 127D. Fig. 127E.

It will be highly instructive to study the image in its gradual evolution as the aperture of the Microscope object-glass is increased.

In order that any structure may be shown at all, we must have at least two maxima entering the objective—say the direct light and one of the innermost spectra. If we admit the direct light and the spectrum A_1 in the manner illustrated in fig. 127A, the Microscope will show the lines a in fig. 125, from which the spectra A_1, A_2, etc., are derived. If we admit the direct light and the spectrum B_1 as shown in fig. 127B, we obtain an image displaying the corresponding lines b of fig. 125. Evidently, either of these images is

unsatisfactory, inasmuch as it discloses only a part of what is capable of being shown by the object-glass. And this leads us to the discovery of an important advantage to be derived from the use of an extended source of light—or, in other words, of a large cone of illumination. For in that manner we can obtain the effects shown in fig. 127A and fig. 127B simultaneously and superposed, leading to the formation of an image showing bright lines corresponding to *a* and *b* of fig. 125, and with the points of intersection, which will be noted to correspond to the actual dots, specially bright as the light of both systems of lines is there added together. The simple expedient of using a wide cone of illumination, being equivalent to oblique light in all directions, has, therefore, at once produced a tolerably good indication of the actual nature of the object. We can derive yet another lesson from this observation. On inspecting figs. 127A and 127B it will be seen that direct light in the central part of the aperture is useless for the purpose of showing any structure, because no corresponding diffraction-spectrum can enter through the available aperture of the object-glass. Such light can, therefore, only form a general bright illumination of the field; cutting it off by a central stop, and thus producing *annular illumination*, must improve the clearness of the image, and this would appear to be a perfectly legitimate means of attaining the utmost distinctness in the image of structures close to the limit of resolution of an object-glass.

We proceed to study the effect of an increase of aperture.

No new spectra can enter unless the aperture is at least equal to the diagonal of the squares into which the spectra of fig. 125A arrange themselves. When that aperture is slightly exceeded, we have the possibility of three distinct combinations of maxima which can enter the increased aperture, viz.:—

1. In accordance with fig. 127C we can have a beam of direct light, and the two diffracted beams A_1 and B_1 derived from it. We have thus three separate beams capable of interfering with each other. The direct light and A_1 alone would meet in equal phase and produce bright *lines* corresponding to *a* in fig. 125; the direct light and B_1 would similarly produce *lines* like *b* in fig. 125. When all three are admitted at once, then they will all meet in the same phase and produce a very pronounced maximum of brightness at the *points* of intersection of lines *a* and lines *b* in fig. 125; in other words, these three maxima lead to the formation of the correct *dot* pattern. When added to the crossed-line effect—with enhanced points of intersection—resulting from the combinations illustrated in figs. 127A and 127B, they will further accentuate the dots, and thus improve the verisimilitude of the image.

2. We may have groups like that in fig. 127D—i.e. the direct light, the spectrum, B_1 (or A_1), and one of the remoter spectra, D_1 (or C_1). By similar reasoning we find that the points of inter-

section of lines *b* and lines *d* will be brought out as bright dots; reference to fig. 125 shows that these again exactly correspond to the true position of the actual perforations; this new combination of maxima, therefore, further improves the image.

3. Finally, we may have four maxima such as direct light and spectra, A_1, B_1 and D_1 admitted simultaneously—fig. 127E.

We again obtain very bright dots at the points of intersection of lines *a*, *b* and *d* in fig. 3—i.e. in the position of the actual dots.

This small increase of aperture is, therefore, sufficient to emphasise the bright dots to such an extent as to render them unmistakable.

The qualitative method of discussing the results to which I am

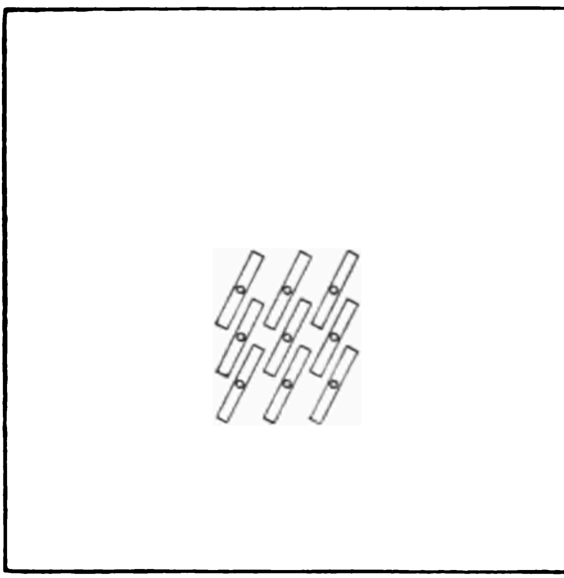


Fig. 128.

at present limiting myself is not adapted to bring out all peculiarities of the different partial images, such as the secondary maxima (intercostals) resulting with combinations of maxima like figs. 127C, 127D, and 127E, nor to show that these secondary effects are different with the different combinations, and are more or less neutralised when they are all superposed. These finer points must be left for a rigorous quantitative treatment of a few judiciously selected cases which I hope to bring forward on a future occasion. What has been stated above will suffice for the present to show that with a perforation pattern also there must be rapid improvement of the image with increasing aperture.

I purposely chose a pattern of *small* perforations; with large perforations we have the possibility of reversed phase in some of the spectra—in fact, we may have perforations such that even some of the innermost spectra will be reversed in phase. I must leave these to be dealt with separately, merely pointing out now that it is found that the phase-reversals again prove to be the agency through which the finer peculiarities of the structure are brought out in the image. Fig. 128 illustrates a possible case of this kind: the long oblique perforations will be noted to be formed round the centres of the small dots of fig. 125; they are, therefore, arranged in the same configuration as fig. 125, and give diffraction-spectra arranged in the manner of fig. 125A, but it is not difficult to see on reference to my former paper that the spectra A_1 will be reversed in phase.

We will next briefly study the image to be obtained of the *reciprocal* grating corresponding to the one discussed above, i.e. a *black* dot design of which fig. 125 would be an actual (positive) representation. From what has been said concerning Babinet's theorem, it will be clear that, referred to the lines connecting the black dots, all the inner spectra will now be *opposed* in phase to the direct light, i.e. the light of all these inner spectra will arrive at the corresponding lines of the image in the phase opposite to that in which the direct light reaches them, and there will, on the other hand, be a tendency to form bright lines *midway between* the lines *a*, *b*, *c*, etc., of fig. 125. In the cases represented in figs. 127A and 127B we shall thus obtain intersecting bright lines midway between the lines *a* and *b* respectively which leave dark spots between them precisely corresponding to the real dots of the object. Similarly, the combinations of spectra 3 and 4 shown in figs. 127C, 127D, and 127E, now lead to the formation of bright dots at various points *between* the dark dots of the pattern, thus leading to a more and more uniform filling with light of the spaces outside the true images of the black dots, and to a corresponding improvement in the verisimilitude of the image of the black dot pattern.

The triangular pattern represented in fig. 126 may be similarly discussed; we again find first intersecting lines indicating fairly accurately the position of the actual bright or black dot, and next, as soon as more than two maxima are admitted by the object-glass, the formation of bright dot images which are so distributed as to improve the resemblance between object and image. The only difference is that a very much smaller increase of aperture leads to this latter result in the case of the triangular pattern than in the more fully discussed case of a pattern arranged in perfect squares, for the simple reason that a circle only slightly larger than that required to enclose say the direct light and spectrum A_1 of fig. 126A will suffice to embrace three adjacent maxima, such as direct light and spectra A_1 and B_1.

On the other hand, it will be seen by reference to fig. 126A that

the triangular pattern is at a disadvantage when a still further increase in the number of spectra admitted is aimed at; it evidently requires a very considerable increase of aperture to bring into action any of the outer circle of spectra. Both these peculiarities of a triangular design are well exemplified in the case of *Pleurosigma angulatum*. Any objective which resolves the structure at all—and a numerical aperture equal to 0·55 will do this—will show the familiar dots, provided the objective be well corrected. On the other hand, it is very difficult to attain a pronounced advance on that image, even with oil-immersion objectives.

It would be useless to attempt a very precise discussion of the image of any dot-pattern by simple reasoning; this must be left for another occasion, when I propose to treat concrete cases mathematically.

We will instead try to draw some further conclusions from the above general discussion.

In the previous paper I showed that one important advantage resulting from the use of an extended source of light, or of a wide illuminating cone, was that the want of focus of an elementary diffraction-image was overcome and replaced by a well-defined focus, such as one expects with an optical instrument. The study of dot-patterns enables us to see another and even greater advantage. In order to obtain extreme resolution with a narrow beam of light, we must let it enter obliquely, through the marginal zone of the object-glass. But that gives us the high resolving power in one direction only—along the diameter of the object-glass having the direct light at one of its ends; it leads to the formation of a misleading image, inasmuch as fine detail is shown in that one particular direction, whilst detail no finer, perhaps even considerably coarser, in other directions is not even hinted at. *A well-centred illuminating cone overcomes this; it gives us equal resolving power in all directions*, and thus brings into view everything that a given objective *can* resolve, *no matter in what directions the structural details may be arranged*. Here, then, is a full explanation of the necessity of a uniformly bright and well-centred cone of illumination. Any want of centring, any dark or coloured portions in the circle of light at the back of the objective, imply a want of symmetry in the image, and a corresponding danger of misleading images. It will, indeed, be found, when the nature of "critical illumination" is impartially examined, that the type of image looked for with such illumination is invariably obtained when, on looking down the tube, a uniformly bright and perfectly centred circle of illumination is seen—*no matter how obtained*—and that the critical image is as invariably absent when examination of the back-lens shows any want of uniformity or symmetry in the said circle, no matter how brought about.

I indeed venture to suggest that "aplanatic cones" or "critical light" would be more scientifically described and specified as "concentric illumination."

There is yet another advantage accompanying the use of extended cones of illumination, viz., the certainty that the objective is free from serious rests of spherical aberration, for only a well-corrected objective will bear a wide illuminating cone. The danger of utterly false images is a very grave one, when only a very narrow beam of light is employed; we may then obtain a sharp image although there is considerable spherical aberration, and as the latter is equivalent to inequality of the optical paths between conjugate points, it will be seen that the phase-relation between the direct light and the diffraction-spectra, which I have shown to play a most important part in the formation of images, will be entirely falsified by spherical aberration, and that misleading images must result.

It only remains to bring forward some strong evidence in favour of the position which I took up in the early part of my former paper, i.e. the claim that *all* microscopical images were due to the diffraction produced by the object.

The chief *theoretical* arguments in favour of this somewhat revolutionary postulate were given in the former paper, and have not as yet been called into question; there is, however, *experimental evidence* tending in the same direction.

The first of these experimental facts is one of which I myself often make practical use in the testing of Microscope objectives. It is this: if we examine a *broken* specimen of *Pleurosigma angulatum* (showing the familiar postage-stamp fracture) with a wide "aplanatic cone" of light, using a dry objective, we obtain a remarkable result if spherical aberration is present, i.e. if the wrong tube length is employed.

At one focal adjustment the broken edge is clearly discernible, whilst by varying the adjustment the dots may be brought into view. As the fracture and the structure are really in the same plane, this is utterly inexplicable on the basis of the spurious disk theory; it is irreconcilable with the assumption that the object behaved as if it were self-luminous, for in that case all parts of the object would have their images formed by the same process and in the same plane.

The diffraction-theory on the other hand explains this quite easily and naturally.

The broken edge produces a narrow fan of diffracted light closely surrounding any ray of direct light; the image of the broken edge is due to such confined pencils of diffracted light passing through the axial portion of the object-glass; for owing to spherical aberration affecting (when of fairly moderate magnitude)

only the outermost zone of an object-glass, a large central portion of the aperture is capable of yielding a good image of such a coarse structure, which is only "fogged" by the scattered light which has passed through the marginal zone. The dots, on the other hand, are brought out by the regular diffraction-spectra corresponding to them, and in accordance with figs. 127A to 127D, combinations of these can only enter through the marginal zone; the image of the dots therefore is formed by, and indicates the focus of, the marginal zone, whilst the image of the outline is due to light passing through the axial portion of the object-glass.

This peculiarity of the image formed by an under- or over-corrected objective may therefore be claimed as constituting a proof that objects do *not* behave as if they were self-luminous.

An even more remarkable fact bearing on the subject is mentioned in our standard handbook of Microscopy.* It is that with difficult diatoms resolution is sometimes emphasised when an analyser is interposed between the object and the eye. As it is universally accepted as a criterion of a self-luminous object that the light from it is quite free from any trace of polarisation, this observation again proves that the object does not behave like a self-luminous body. At the same time it is a remarkable piece of evidence in favour of the Abbe theory; for when the effect of gratings is studied more rigorously than by the usual more or less elementary approximation, *the result is arrived at that the diffracted pencils are polarised,* the amount of the polarisation depending largely on the angle between the direct and the diffracted light, but also on the nature of the edges of the slits, etc. This observation, which in the above quoted passage is put forward as a puzzling one, is therefore a direct refutation of the spurious disk theory and an equally direct proof of the correctness of the Abbe theory.

The chief results of this inquiry into the theory of microscopical vision may now be summarised as follows:

1. The spurious disk theory, being based on the inadmissible assumption that microscopical objects could be made to behave as if they were self-luminous, must be abandoned.

2. The images obtainable from plane gratings of various types can be fully accounted for by the Abbe theory, provided that the phase-relation as well as the intensity of the diffraction-spectra is taken into consideration.

3. The advantages derivable from so-called aplanatic cones of light are:

(*a*) That the image acquires that fixity of focus which is desirable and indeed necessary in order to distinguish spurious "ghosts" from the image formed in the plane of the geometrical image.

* Carpenter, Dallinger, 8th edition, bottom of page 381.

(*b*) That we obtain equal resolving power in all directions, and can therefore see simultaneously everything that a given combination of condenser and objective can show.

(*c*) That false images, due to a badly corrected object-glass, are not likely to deceive the observer, because such objectives will not bear this mode of illumination.

4. One other important result has been arrived at since this inquiry was opened, and is, I believe, largely due to it.

It is a *warning against dark-ground illumination.* In supplying an experimental proof of the phase-reversal in diffraction-spectra I also showed that with dark-ground illumination a grating may be seen *reversed,* i.e. bright where it ought to be dark, and *vice versâ.*

Mr. Rheinberg has shown an even more remarkable experiment at the Royal Institution and again at the Quekett Club, viz. that with dark-ground illumination we may see a grating *doubled* under otherwise perfectly normal conditions.

NOTES.

*The Movements of Diatoms and other Microscopic Plants.**

By Daniel D. Jackson.

Few subjects in the domain of Cryptogamic Botany have given rise to more speculation and conflicting theories than have the studies into the cause of the apparently voluntary movements of diatoms. From time to time for the past twelve years the author has been confronted with this seemingly fruitless subject, and only recently, almost by accident, has the problem been solved.

It was early shown by examination in closed cells that the phenomenon was not due to external currents set up in the surrounding liquid, but that the power of motion came from the organism itself. Largely on account of these movements, which appeared to be spontaneous and voluntary, the diatoms were originally classed in the animal kingdom.

The first theory which naturally presented itself was that they move, as do the infusoria, by means of vibrating hair-like processes called cilia or flagella. Later, certain authors claimed to have seen protoplasmic processes similar to those of the rhizopods protruding from the small openings in the frustule of the organism. Then came the theory of Onderdonk,† which described the progression as due to a thin fluid mass in rhythmical motion covering the surface of the diatom.

Nägeli suggested that the motion is due to endosmotic and exosmotic currents, and H. L. Smith,‡ after much study of the subject, came to the conclusion "that the motion of the Naviculæ is due to injection and expulsion of water, and that these currents are caused by different tensions of the internal membranous sac in the two halves of the frustules."

In order to prove this theory, Professor Smith showed, by means of suspended indigo, that when the diatom moves forward the particles of indigo gather around the central nodule of the valve and form a small mass, which turns on itself just as if it were impelled by a jet of water proceeding from the valve at this point. Each of these little turbulent spheres, after having acquired

* This paper, read at the May Meeting of the Society, had been previously communicated to the New York Microscopical Society on April 7, 1905.

† "The Movements of Diatoms," Microscope, August 1890.

‡ "A Contribution to the Life History of the Diatomaceæ," Proc. Amer. Soc. Microscopists, 1888.

a certain size, falls apart, and the particles which compose it are driven along the valves from front to back, and accumulate behind the extremity of the frustule which, according to its progression, would be considered the rear. The particles move as if they were subjected to a current going from front to back, and reverse when the motion is reversed. That these currents exist there can be no doubt, but that the motive power is not due to the expulsion of water will shortly be demonstrated.

The first intimation of the true nature of this motion was suggested by the action of a lithia tablet in a glass of water. The bubbles of carbonic acid gas given off set up the exact motions in the tablet that have been so often described for the movements of diatoms—"a sudden advance in a straight line, a little hesitation, then other rectilinear movements, and, after a short pause, a return upon nearly the same path by similar movements."

Repeated experiments with compressed pellets evolving gas have shown that this is the usual motion produced by the evolution of gas bubbles; and when pellets were made of the same shape as Naviculæ, the movements of these diatoms were perfectly duplicated. Boat-shaped pieces of aluminium, 2 mm. thick, were then made, and on them were cut longitudinal grooves to resemble those of the diatom. When placed in strong caustic soda solution, the movements of the metal produced by the evolution of hydrogen gas again duplicated those of the diatom in a remarkable manner. The metal having the grooves had a greater power of motion than that without the grooves.

If we consider that the diatom contains chlorophyll bands which, when exposed to a strong light, rapidly evolve oxygen, and if we take into account the fact that the motion does not take place unless the light is fairly strong, we have then a conception of the nature of the movements of these organisms. Streams of oxygen may be readily seen evolving from all parts of many of the larger aquatic plants when submerged in water and exposed to strong light; but in the diatom, while the gas produced is large compared with the size of the organism, the actual amount evolved is so small that it is taken into solution almost immediately. That such evolution takes place, however, is shown by Professor Smith's experiments with indigo. If, now, we examine the artificial diatom made of aluminium, and placed in strong caustic solution, we find that the bubbles from all sides come together and rise in a line corresponding to the median line or raphe of the organism, and that if indigo is placed in the liquid it collects and rotates near the central nodule, just as described by Professor Smith to prove his theory of the presence of water currents.

It is, therefore, evident that the motion of diatoms is caused by the impelling force of the bubbles of oxygen evolved, and that the direction of the movement is due to the relatively larger

amount of oxygen set free, first from the forward and then from the rear half of the organism. This accounts for the hesitancy and irregular movements, as well as the motion forward and backward over the same course.

The evolving gas seems to act at times as a propeller to push the organism forward, and at other times to exert a pulling action to raise the growth on end. The various movements described are the resultants of varying proportions of both of these active forces.

The fact that a longitudinal groove on the under side of the artificial diatom causes it to become more active, due to the expulsion of the gas along the line of the groove, explains the reason for the greater activity of the Raphideæ.

The most interesting and peculiar movements among diatoms are those of *Bacillaria paradoxa*, whose frustules slide over each other in a longitudinal direction until they are all but detached, and then stop, reverse their motion, and slide back again in the opposite direction until they are again almost separated. When the diatoms are active these alternating movements take place with very considerable regularity. It is probable that the individuals in a group of *Bacillaria* are joined together much more loosely than other laterally attached genera, and that when a forward movement takes place in the outer individual it is arrested by capillarity just before the diatom is completely detached.

It can now be readily seen that the strange movements of the other microscopic plants may be explained as also due to the evolution of oxygen gas. While the movements of desmids are not as strongly marked as those of diatoms, many of them, notably *Penium* and *Closterium*, have often been described as having a power of independent motion, and Stahl * found that this motion is greatly affected by light.

The best account of the movements of desmids has been given by Klebs.† This author speaks of four kinds of movements in desmids, viz. :—

1. A forward motion on the surface, one end of each cell touching the bottom, while the other end is more or less elevated and oscillates backwards and forwards.

2. An elevation in a vertical direction from the substratum, the free end making wide circular movements.

3. A similar motion, followed by an alternate sinking of the free end and elevation of the other end.

4. An oblique elevation, so that both ends touch the bottom, —lateral movements in this position ; then an elevation and circular motion of one end, and a sinking again to an oblique or horizontal position.

* Verhandl. Phys. med. Gesell. Wurzburg, 1880, p. 24.
† Biol. Centralbl., 1885, p. 353.

This observer considered these movements to be due to an exudation of mucilage, and the first two to the formation during the motion of a filament of mucilage, by which the desmid is temporarily attached to the bottom, and which gradually lengthens.

These four kinds of movements are very easily explained by the theory of the evolution of gas; and by regulating the conditions they can be exactly reproduced in the artificial desmids made of aluminium. In this case strips of thin aluminium foil should be used. When the gas production is very strong at one end, the desmid will be raised to a vertical position and will take up oscillating or circular movements.

If we now pass to a consideration of like movements in the Cyanophyceæ, the same explanation holds true for *Oscillaria*, which often takes up a waving or circular motion when attached at one end. This movement is well described by Griffith and Henfrey * as follows:—"The ends of the filaments emerge from their sheaths, the young extremities being apparently devoid of their coat; their ends wave backward and forward, somewhat as the forepart of the bodies of certain caterpillars are waved when they stand on their prolegs with the head reared up." The authors attribute this motion to "irregular contraction of the different parts of the protoplasm."

The free-swimming species of *Nostoc* all have a spontaneous power of active motion in water, and in all of the filiform orders of the Cyanophyceæ detached portions of the filament known as hormogones also have the power of spontaneous motion. All of these movements are undoubtedly the effect of the evolution of oxygen gas.

On "An Optical Paradox."

Dr. G. Johnstone Stoney, F.R.S., takes the subject † up from the point of view of "Flat-wavelet Resolution," and remarks that Lord Rayleigh's experiment ‡ may be conveniently adapted to the Microscope.

The image of L in the telescope T of the diagram, fig. 129, is formed by the mutual interference of all the undulations of flat wavelets, which enter the telescope in the direction of the so-called "rays" that proceed from the image of A at C. The image of A at C is the spurious disk and diffraction appendages formed by lens L. The outline of L will be properly seen so long as the telescope objective admits, in addition to the spurious disk, some part of the

* Micrographic Dictionary, p. 561.

† Phil. Mag., July 1905, pp. 126–8. ‡ See this Journal, ante, p. 417.

appendage rings, or else portions of two or more of these rings if all light from the spurious disk is excluded. If the aperture of the objective is cut down till the disk only is admitted, the definition will have become so bad that the outline of L cannot be seen. The most satisfactory image of L will be formed, when the spurious disk and all its diffraction appendages that have any appreciable brightness are admitted by the telescope objective.

The degree of definition—i.e. the steps from good to poor definition—can be easily investigated by the "flat wavelet resolution" analysis, and it also shows that when the source of light A is enlarged, there is no necessity for any phase relation between the portions of light emanating from different puncta of A. The needful phase relation—the one necessarily subsisting—is that between the disk and the diffraction appendages formed from each separate punctum of A. It follows, and is confirmed by experiment, that the source of light may, without loss of definition, be a self-luminous body.

To understand how Lord Rayleigh's experiment, and others

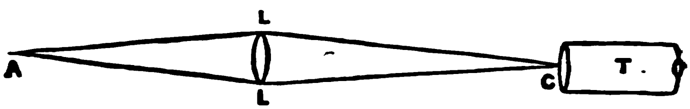


FIG. 129.

related to it, can be made with the Microscope, remove lens L of the apparatus represented by the figure in the text, and replace it by two lenses L′ and L″, of which lens L′ collimates the light from A, while L″ concentrates the collimated beam to a focus at C. It is obviously legitimate to make this substitution. When the experiment is made with a Microscope, the source A is to be light passing through a small hole (or slit) in a stop placed under the condenser. The condenser of the Microscope then takes up the duties of lens L′, and at the same time the objective of the Microscope discharges the functions of the combination consisting of lens L″ together with lens C. The image of A produced at C then becomes that image of the hole (or slit) which may be seen in the "concentration image" of the Microscope—i.e. in the image which comes into view on removing the eye-piece and looking down the Microscope tube. Furthermore, when the experiment is made with the Microscope, any desired object can be put upon the stage of the Microscope, and becomes the object to be resolved. The author considers the best object to employ is one of the bands of Grayson's Rulings, supplemented by observations upon a single pair of lines such as may here and there be seen to project from one or other end of a band. The hole in the stop may, if desired,

be made to behave as a self-luminous source of light, by focusing the light of the lamp-flame or other luminary upon the stop. This will be found in no degree to impair definition, whether the hole in the stop be large or small.

The Optical Convention.

AT the Optical Convention which was held at the Northampton Institute, Clerkenwell, from May 30 to June 3, with the object of promoting the science and industry of Optics in Great Britain, the President, Dr. R. T. Glazebrook, F.R.S., in his inaugural address, passed in review the history of optical progress since early times, dealing more particularly with a few periods of marked progress, to show how theory and practice had acted and reacted upon one another, and how necessary it was that close co-operation between those interested in the scientific and technical sides of the question should exist for the proper and prosperous development of British Optical Industry. The first period selected for illustration was the end of the seventeenth century, when the influence of the work of Christian Huyghens and Sir Isaac Newton made itself powerfully felt. Another period dealt with was about 100 years later, when the researches of Thomas Young and Fresnel entirely changed the whole of the theory on which the construction of optical instruments depended. An example was also given of the adverse and retarding effect of the want of co-operation between science and practice. Early in the nineteenth century Sir George Airy and Sir William Hamilton had investigated the aberration of lenses. When a generation later Daguerre announced his invention, this work would have been of the greatest value to the designers of photographic lenses. It was, however, forgotten, and the last place where the practical opticians of that time might have been expected to look for help were such publications as the Transactions of the Cambridge Philosophical Society, or the Royal Society of Dublin. They worked on empirical lines, with the result that the main improvements had taken place in another country, where the opticians had been quicker to recognise that a full knowledge of the action on a lens of the light which traverses it was the condition precedent to further advance.

The last illustration chosen to emphasise the beneficial effects of intimate co-operation between science and industry was the history of optical glass manufacture. After a brief reference to the invention of optical glass by the poor carpenter Gunand in 1740, whose son, after his father's death, sold the secret to George Boutemps, who was brought to England by Messrs. Chance, the

President dealt with the work of Abbe at Jena, as perhaps the most striking example of the results accruing from the reasoned combination of theory and practice. Sketching Abbe's career, he passed on to his work on the theory of the Microscope, pointing out that it was the direct outcome of the work of Fresnel. Abbe's work soon led him to realise that for Microscope objectives no great improvement could be expected with the glass at the optician's disposal—a result which had likewise been arrived at by Petzval and von Seidel in regard to photographic lenses. Theoretical work thus indicated a bar to progress only to be overcome by the manufacture of new glasses. This fact had also been recognised by our countrymen, Mr. Vernon Harcourt and Professor Stokes, who had for some eight years previous to 1870 endeavoured, but with scant success, to produce glass having certain definite relations between dispersion and refraction. Abbe was more successful: his writings attracted the attention of the glass-maker Schott, and their researches, aided in the first instance by a large grant from the Prussian Minister of Education, had led to the present well-known industrial results. Nor was this all; for, in virtue of the distribution of profits settled by the scheme of the Carl Zeiss Stiftung, the University of Jena alone had received a sum approaching 100,000*l*. No better illustration, perhaps, could be found of the way in which progress depended on the co-operation of science and experience.

A fitting accompaniment to the President's address will be found in the volume of the Proceedings of the Optical Convention, in the shape of an historical chart by Mr. F. J. Chesire, F.R.M.S. This chart contains the names and dates of birth and death of the foremost workers in optical science, and is conveniently arranged to show at a glance the periods of particular progress.

The programme of the Convention can be classed into two divisions; the reading and discussion of papers, and a representative exhibition of optical and scientific instruments of British manufacture. The following abstracts of papers which have a bearing on the Microscope are given in the alphabetical order of the authors' names. Those marked with an asterisk have been kindly abstracted for the J.R.M.S. by the authors themselves.

* The Consideration of the Equivalent Planes of Optical Instruments.

By *Conrad Beck, F.R.M.S.*

The author explained that in all dioptric optical systems there are two well-known pairs of planes, known as the principal and nodal planes respectively, which, when the media on both sides of the instrument are the same, such as air, are superimposed in one pair of planes possessing the characteristics of both, and are known as the equivalent planes.

In considering optical instruments, some system of measurement and

nomenclature must be used. Any such system required that the value of the focal length should be known. In a single thin convex lens the distance of the solar focus or burning point from the edge of the lens gave this important measurement; but in compound instruments, although the focal point could often be found, that portion of the instrument from which it should be measured in order to obtain the true focal length was more difficult to determine.

Early English writers attempted to express this position by such terms as "optical centre," or "perspective centre," but without a true understanding of the correct principle, and they preferred to deal with an instrument as a series of component parts, rather than as a whole.

Fifty years previously it was thoroughly understood on the Continent that there is no one position in an optical system from which the optical measurements should be made, but two "equivalent planes," one for incident light measurements, the other for emergent light measurements.

Mr. Beck then showed, with the aid of a diagram provided with a movable slide, that the most complex instruments can for most purposes be represented by a thin lens of a certain focal length, if we imagine it to be placed first, in the first equivalent plane to receive the light, and then shifted to the second equivalent plane to discharge the light. The focus of such a lens is the equivalent or true focus of the compound instrument, and the position of the equivalent planes becomes of prime importance.

The author then explained diagrammatically how the separation of two single convex lenses profoundly altered their position. Starting from two lenses close to one another, he explained how the equivalent planes move away from each other, and cross as the two lenses are separated, going to infinity when the lenses are situated at a distance apart equal to the sum of their focal lengths, reappearing on the other side of the lenses on further separation. The argument was then applied to combinations of positive and negative lenses with similar results.

He then proceeded to illustrate the various types of instruments: the photographic, or projection lens, the Telescope and the Microscope, by means of the same pair of lenses separated by different amounts; showing how the telephoto lens, and especially the compound Microscope obtained their distinctive advantages by the position in which their equivalent planes were placed.

A Microscope of the highest power considered as a whole, has an equivalent focal length of only a few thousandths of an inch, the object being placed approximately at the focal point. The earliest Microscopes were constructed like our pocket magnifiers of single lenses of various curvature. Such lenses could only be made of comparatively small magnifying power, and even then the object had to be placed very close to the lens. If we could conceive of a single lens with a magnifying power of 2000, the focal distance would only be $\frac{5}{1000}$ or $\frac{1}{200}$ inch, and the object would be so close that it could not even be protected by a thin cover-glass. It is, however, interesting to note that lenses of different shapes, although they are single lenses, are suitable to a greater or less extent for increasing this so-called working distance, owing to the different position of their equivalent planes.

For obtaining high magnifications, single lenses cannot be made with sufficiently strong curvature, and the first idea that suggests itself is to place three or four powerful lenses close together. Such an arrangement, however, is even more unsuitable, because the equivalent planes are generally somewhere between the lenses, and the actual distance of the focus from the front lens is reduced still further than in the case of a single lens.

So it was, that without knowing the exact reason, the plan of using lenses separated by large intervals was adopted in Microscopes as far back as the year 1650. The equivalent planes are so placed that one of them is

at a considerable distance from the lenses, and even if the focal length of the complete instrument were $\frac{5}{1000}$ inch there is ample room for manipulating the object. The modern compound Microscopes consist of two positive lenses separated by a large interval, and the two equivalent planes are outside everything; the object to be examined and the observer's eyes are inside.

Mr. Beck then urged the importance of examining instruments as a complete whole with a view to seeing if, by re-arrangement of parts, new positions could not be found in which the equivalent planes might be placed in order to confer fresh capabilities, and concluded by treating the case of the human eye and spectacles, deducing several curious facts as to the size of the picture received upon the eye, firstly, in cases of high myopia corrected with spectacles, and secondly, in cases of cataract with the crystalline lens replaced by powerful convex spectacles.

On Certain Methods of Lens Measurement and Testing together, with some Recommendations as to Nomenclature and Description.

By *T. H. Blakesley.*

The instrument used is in essence a collimator, for it consists of a scale of a few divisions at the principal focus of an achromatic lens. It is fitted to the stage of a Microscope, being placed through the hole in the stage, upon which it rests by means of a collar near the lens. The collimator lens itself is turned towards the Microscope, and the lens or lens systems, the measurements of which are to be determined, are placed between this collimating lens and the Microscope objective. The method may be employed for determining the focal lengths of lenses, the distance between the principal focus from surfaces of a lens, the ratio of the radii of the surfaces of a single lens, the distance between the second principal focus of one lens and the first principal focus of the second lens in a combination of two lenses, the curvature of lens surfaces, and it has also been applied to measure the index of refraction of a liquid. With regard to determining the focal length of lens systems, the method was found applicable to an entire Microscope, the tube of which was not long.

*Aberrations.

By *S. D. Chalmers, M.A.*

The author discusses practical means for measuring by observational methods the aberration of lenses, more particularly photographic lenses, on the system employed by Hartmann for telescope objectives. It is pointed out that it has not been possible, as yet, to apply the method to Microscope objectives with sufficient accuracy.

*Measurement of Refractive Index.

By *S. D. Chalmers, M.A.*

The paper describes a new and accurate method of determining the refractive index of glass in the form of a lens.

The lens to be tested is inserted in a liquid whose refractive index can be measured, and the refractive index is determined from the formula $n_2 - n_0 \, (R_1 - R_3) =$ the power of the lens (when immersed in the liquid). Where n_2 is the refractive index of the lens, n_0 of the liquid, R_1 and R_3 the curvatures of the lens; the latter need only be known approximately. To

determine the power of the lens, a subsidiary lens is used to focus a bright object, the image being observed by a high-power eye-piece.

In front of the subsidiary lens is placed a plane parallel trough, containing a transparent liquid, such as clove oil or immersion oil.

The bright object is focused, the lens is inserted in the trough, and the object re-focused. If v_1 and v_2 be the focusing distances—

$$\frac{v_1 - v_2}{v_1\, v_2} = \text{power of the lens as used,}$$

and $v_1 - v_2$, v_1 and v_2 must be measured with the same proportionate accuracy as is required in $n_2 - n_0$.

The paper contains a list of readings showing that an accuracy of 0·0005 was obtained, and the author claims that with specially designed apparatus the error could be reduced to 0·0001, and that the values of the dispersion could be obtained with the accuracy of spectrometer measurements.

To avoid the errors in the refractive index of the liquid due to temperature variations, the trough is made in the shape of a prism, and any variation in the temperature causes the image to move in the field—thus permitting of a correction being made for temperature errors. For obtaining the refractive index of the liquids, standard lenses are used.

The Specification and Measurement of Optical Aberrations.

By *C. V. Drysdale, D.Sc.*

This paper is a general discussion on the aberration of optical instruments. It is pointed out that optical image-forming instruments fall into two distinct classes—objective and subjective. To the former class belong instruments such as photographic lenses, projection apparatus, etc., where the image is formed on a screen, and which are therefore complete in themselves. To the latter class belong instruments such as the Telescope and Microscope, where the final object is to produce a perfect image on the retina of the observer, and therefore these should have their aberration defined with respect to the normal eye.

* Diffraction in Optical Instruments.

By *J. W. Gordon, F.R.M.S.*

In the geometrical representation of a beam of light there are two constituent elements—the rays and the wave-fronts. The rays traverse the beam from end to end and extend in one dimension only. The wave-fronts lie athwart the beam and are extended in the two remaining dimensions. The wave-fronts may be more exactly defined, for they are monophasal surfaces. A wave-front may accordingly be said to pass through all those points in the rays composing any beam which lie at a given optical distance from its point of origin.

It thus appears that the rays intersect the wave-fronts in a beam of light. From the nature of this intersection the type of the beam may be determined. Thus the ray where it intersects the wave-front may be a normal to the surface of the wave-front, or it may meet it at an oblique angle. If the ray is a normal the pencil is normal of which it forms a part, and we have the normal beam of ordinary light which forms the subject of investigation in what is commonly called geometrical optics. But when the angle is oblique the beam is a beam of diffracted light.

The phenomena of diffracted light are usually grouped into two classes, named after Fraunhofer and Fresnel respectively. The Fraunhofer bands

are exhibited outside the geometrical boundary of the normal beam, the Fresnel bands within that boundary. Since in the case of a focused beam of light the normal beam narrows to a point in the focal plane, it follows that Fresnel bands disappear from the focal plane itself, and are therefore of comparatively small importance in the theory of optical instruments. Fraunhofer bands on the other hand are best seen in the focal plane, and for this reason they are of great importance for the theory of optical instruments, where they give rise to the phenomena of the false disk, intercostal figures, and the like—in one word, to the phenomena connected with what has been called the antipoint. It is from this point of view that the Fraunhofer diffraction phenomena have been exclusively studied, and consequently the account given of them in the accepted text-books is limited to their appearance in the focal plane.

It was suggested in the paper that this restriction of the attention of students to the phenomena exhibited in the focal plane leads to a misunderstanding, both of the nature and of the importance of the Fraunhofer bands, and in illustration of this point the author referred to an investigation of

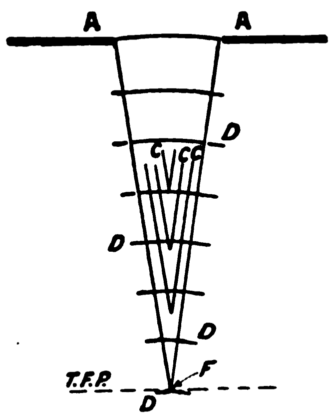


FIG. 130.

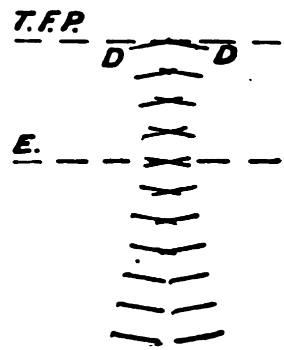


FIG. 131.

the Fraunhofer phenomena in planes other than the focal plane, some results of which had been communicated in a paper read by him before the R.M.S. in December last.* In the mathematical part of that paper it was shown that if a mode of calculating the intensity of Fraunhofer rings is adopted, which is applicable to rings lying in these afocal planes, these rings can be shown to be in theory conical wave-fronts which, starting from the diffracting aperture, travel down outside the surface of the normal beam, forming a fringe of light having the form of a conical wave-front. This conical wave-front intersects the surface of the normal beam at right angles, and forms a tangential extension of the spherical wave-fronts occupying the interior of the beam. The diagram, fig. 130, illustrates according to this theory the anatomy of a focused beam of light. Here AA is the aperture defining the beam, F the focal point. The circular arcs struck about F represent the wave-fronts of normal light. CCC are traces of the dark intervals between the Fresnel rings. DDD are the conical wave-fronts of the Fraunhofer ring.

* J.R.M.S., 1905, p. 1.

TFP is the theoretical focal plane. Only one Fraunhofer ring—the innermost—is represented, and this one only is of any great practical importance.

It will be observed that the Fraunhofer ring forms at the focal plane a cone having its apex in that plane. If we assume that it continues to be propagated inward according to the ordinary law of light propagation along rays normal to the wave-front, it will follow that this conical wave-front will continue to contract upon its own axis, and that at a distance determined by the divergence angle of the normal beam it will reach its point of greatest condensation. Fig. 131 shows diagrammatically the production of this result. Now if such a condensation of the focused light takes place in the plane E of fig. 131, it is clear that the image of a point source of light must be better defined in this plane E than in the theoretical focal plane; from which again it would follow that the effect of Fraunhofer diffraction is not only to impair definition in the focal plane itself, but also to displace the effective focal plane to a position behind that of the theoretical focal plane. The author proposes as an approximate expression for the extent of this displacement $\Delta = \frac{\cos u\,\lambda}{\sin^2 u\,4}$ where Δ = the displacement, u = the divergence angle of the focused beam, and λ = the wave-length of light. This expression, when highly magnified images are formed, becomes $\Delta = \frac{M^2\lambda}{4}$ where M = the scale of magnification.

The theoretical position having been thus defined, its bearing upon certain obscure problems of practical optics was next discussed. First there is the fact with which every photographer is familiar, that for really critical focusing it is necessary to focus with the particular stop with which you intend to operate during exposure. Another fact of the same class is that when a Microscope is adjusted for high power work the focus is immediately disturbed by any change in the adjustment of the substage condenser, and that if in this way the angle of the light is altered even slightly, a corresponding readjustment of focus becomes necessary. These are matters quite commonly known. The author added an observation recently made by himself when working with a Microscope arranged to give extremely highly magnified images and fitted with an oscillating screen for increasing the diameter of the emergent pencil. Then it is found that the image seen upon the oscillating screen shows much greater crispness of detail than when seen as an aërial image.

Supplementing these general observations, the author showed some photographs in which negatives obtained in the theoretical focal plane were compared with negatives of the same object obtained in a focal plane displaced in accordance with the expression obtained above for the displacement of the effective focal plane. The results were striking, but not conclusive, and, indeed, the difficulty of determining with exactitude the wave-length of the light which produces a given photograph makes experiment upon these lines much more difficult than would perhaps be expected. The author submitted his results as tentative and immature in their present form, suggesting that they point to a promising field of further investigation.

An Interference Apparatus for the Calibration of Extensometers.

By *J. Morrow, M.Sc.*, and *Professor E. L. Watkin, M.A.*

In research work on the elasticity of metals, in which extensometers of considerable delicacy were employed, some difficulty was experienced in determining the constants of the instruments with sufficient accuracy, because the mechanical devices with which they could be compared would

be liable to defects of the same kind and order of magnitude as those it was required to detect. This led the authors to construct an apparatus based upon interference methods, by which the above difficulty is done away with, as the measurements of the displacements are made directly in terms of a known wave-length of light.

The interference rings produced are viewed through a Microscope, in the eye-piece of which are three cross-wires, one central and at right angles to the other two.

The definition and separation of the rings are sufficiently good to enable one to estimate $\frac{1}{10}$ of the distance between two rings fairly correctly.

Since a shift of one ring to the next, past any given point, is equivalent to one wave-length alteration in thickness of the path which is being measured, a great degree of accuracy is attained.

A full description of the instrument and its mode of application is given.

The Parallel Plate Micrometer.*

By *J. H. Poynting, F.R.S.*

If a parallel plate of glass is interposed between the objective of a Microscope and the object, the image is seen in its true direction when the plate is perpendicular to the axis. When the plate is tilted the image is shifted sidewise, and by an amount which, for angles less than 10 degrees, is very nearly proportional to the tangent of the angle of tilt, and for such angles when a low-power objective is used, the definition is not appreciably impaired by the tilt.

To use the plate as a micrometer, it may be fixed to one end of an axis which turns in bearings and is perpendicular to the axis of the Microscope. A pointer attached to the revolving axis moves over a straight scale, and the number of divisions of the scale from the centre is proportional to the tangent of the angle of tilt, and therefore nearly proportional to the shift of the image. Suppose that it is required to measure the diameter of a small particle. The plate is tilted so that one side, *a*, of the particle is on the crosswire in the eyepiece, and the position of the pointer on the scale is read. The plate is then tilted so that the other side, *b*, of the particle is on the crosswire, and the position of the pointer is again read. The difference of the two readings gives the diameter in scale divisions. The value of a scale division may be determined by using as object a finely divided scale.

The micrometer may be entirely detached from the Microscope, so that in manipulation there is no risk of disturbing the Microscope. There is no backlash.

For powers higher than 1½ or 1 in. there is insufficient space for the plate between the object and the objective, and the tilting affects the definition. The plate may then be interposed in the tube between the objective and the eyepiece, and in this position it is, of course, much more sensitive, and the definition remains good.

In a measuring bench or comparator in the Physical Laboratory of the Birmingham University, we use two Microscopes with 2-in. objectives. The plates are 6 mm. thick, the pointers are 25 in. long, and move on millimetre scales with about 100 divisions for a shift of 1 millimetre.

The parallel plate micrometer was described by Clausen as far back as 1841.† It was re-invented by Porro in 1842.‡ Porro used both the form described above and a double image form for the Telescope. In the double image form there are two plates, each occupying half the field, placed in

* Printed in extenso by permission of the author.

† Ast. Nach., xviii. (1841) col. 95–96. ‡ C. R., xli. (1855) p. 1058.

front of the eyepiece. One is fixed and the other can be tilted about an axis perpendicular to the line of division of the plates.

I have used both forms, and I find both of them exceedingly convenient,

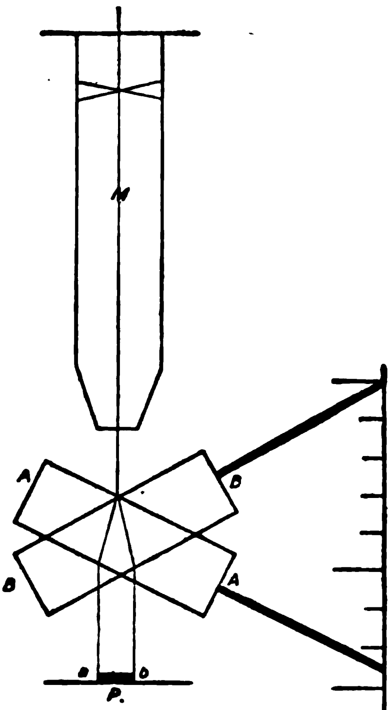


FIG. 132.

rapid, and accurate. The parallel plate micrometer is easily constructed, and is inexpensive. It merits more notice and much more use than it has yet received (Fig. 132).

THE POLISHING OF GLASS SURFACES.

By *Lord Rayleigh, O.M. F.R.S.*

Theoretical treatment of the question consisted in the inquiry into the difference between reflection from a perfectly plane surface, and from one which had corrugations. This difference depended entirely on the relationship between the period of the corrugation—i.e. the distance from ridge to ridge along the surface, and the wave-length of the vibration that was being reflected. The question in connection with gratings had been treated long ago by Fraunhofer, who had drawn conclusions as to the limits of the power of the Microscope, from the fact that when the lines of a grating are closer together than a wave-length, the spectra which would be formed if the grating had been less closely ruled were, so to say, pushed out of the field. With the slight correction that Fraunhofer had not treated the case of

oblique incidence correctly, because the last spectrum did not vanish till the distance between the lines or corrugations was as small as half a wave-length, his arguments had been perfectly sound.

When no diffraction spectra were formed, then the whole of the light must be concentrated in the specially reflected beam, and the corrugations then had no effect. It was, therefore, entirely a question of wave-length. A surface roughened with pebbles might act as a perfect reflector for sound-waves. The author had himself experimented with a piece of ground glass silvered over the roughnesses, which acted as a reflector for dark heat rays, and again, glass might be polished sufficiently finely to reflect red rays fairly well, and yet act very imperfectly as regards reflection of the blue or ultra-violet rays. Herschel had thought that grinding and polishing of glass was of the same nature, that lumps of glass were broken out by the emery with which the glass was brought into contact under pressure. His own observations led to a different conclusion—viz. that polishing, as conducted with rouge imbedded in pitch, or carried on cloth or paper, was essentially different to grinding. When followed under the Microscope, easily done when the surface is smeared over with a little aniline dye, no visible pieces of glass appeared to be broken away at all. The polishing began upon the eminences left by the grinding, little facets were produced, and these grew in size, but the polish on the facets appeared perfect from the very beginning. It appeared to the author that the process was a molecular one, the upper layer of molecules being operated upon by the polishing material. Not that the fact of not being able to observe structure under the Microscope was any proof that no structure existed till they came to the molecular limit, but the impression obtained from the discontinuity of the two processes, led him to think the material was acted on molecularly. It was an important question which it would be useful to get definitely settled. The author observed that his remarks referred solely to hard materials, and not softer ones such as metals, in the case of which Mr. Beilby, who had investigated the matter, considered that the polishing did not consist only in removing eminences, but also in filling up the pits with the material removed from the eminences.

After referring to experiments as to the amount of material removed in polishing glass, the author proceeded to discuss observations he had made on the action of very dilute hydrofluoric acid on glass surfaces. The surface, it was found, could be cut away to any required small depth—such as half a wave-length—in a regular manner. By etching two flat surfaces in strips, and continuing these crosswise, the depths could be so chosen as to give the most brilliant colours of Newton's rings.

The effect of the acid on finely ground glass surfaces, was to eliminate from the roughened surface all the finer irregularities, leaving only those of longer periodicity, and the theoretical reasons for this were explained.

In the discussion which followed, Mr. Rosenhain adduced reasons for believing that in polishing glass a surface flow, similar to that which Mr. Beilby had shown to occur with metals, did take place. Mr. Horace Beck likewise evidenced facts pointing to an actual transference of glass from the eminences of the surface to the adjacent pits.

*A Simple Method of Producing Achromatic Interference Bands.

By *Julius Rheinberg, F.R.M.S.*

This is an account of some experiments on problems connected with microscopic vision which led to an unexpected result in another direction. If a grating is placed on the object-stage of a Microscope and illuminated by a narrow beam of light, it diffracts the light, so that spectra will be formed

in the back focal plane of the objective. The image of the grating results from the reunion of light coming from these spectra, and, according to the well-known law of Abbe, no defined appearance of structure can be seen in the image, unless at least two of these spectra have taken part in its formation.

The aim in view was to see whether, after blocking out all but one of the spectra diffracted by the object, it was possible to produce precisely similar spectra in some other way to replace them, and, if so, what would happen to the image.

An Abbe Demonstration Microscope was used by the author for the in-

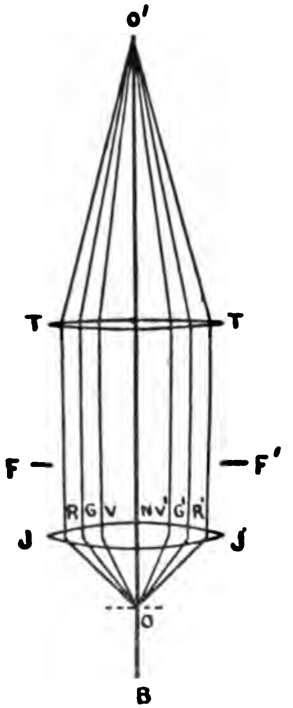


Fig. 133.

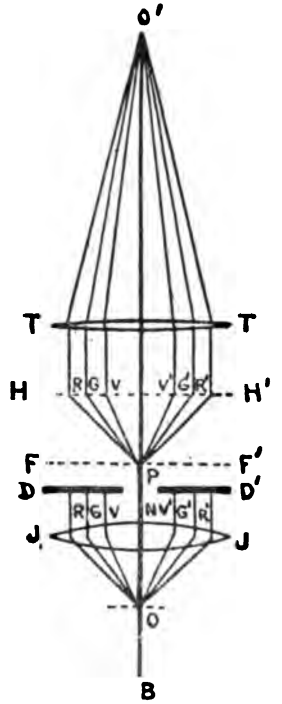


Fig. 134.

vestigation. In this instrument Abbe's view that a Microscope objective is equivalent to a magnifying lens J J (fig. 133), to convert the divergent rays from the object into parallel pencils, and a telescope objective T T to bring these parallel pencils to a focus and produce the image, is embodied in a practical form.

The spectra V G R and $V^1 G^1 R^1$ (fig. 134), diffracted by the object, were blocked out by means of the diaphragm D D,' so that only the central beam (or zero spectrum) was transmitted, and in order to imitate these spectra the device was hit upon to pass the beam through two diffraction gratings of the same pitch. Thorp gratings of about 14,500 lines per inch were used, and are shown at F F^1 and H H^1 (fig. 134).

To consider the action of passing parallel light through two gratings of

the same pitch, let the ray A B (fig. 135) impinge on the grating G^1, and let B C be the dioptric or normally diffracted ray, and B D one of the diffracted rays of the first order to which the grating gives rise. When the ray B C meets the second grating, it again splits up into several proportions, one of them (C E) proceeding in the original direction. When B D meets the second grating G^2 this also is split up, the dioptric portion continuing in the direction D H, and the first diffracted rays proceeding in the direction D K and D K^1. But as the grating is of the same pitch as the other one, the angle between D H and D K must be the same as the angle between B C and B D, so that D K is parallel to A B or C E; that is to say, part of the incident light which was diffracted off a particular angle by the first grating has been again rendered parallel to the incident ray, and consequently also parallel to the transmitted dioptric ray which has not had its direction changed.

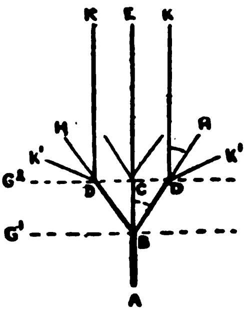


Fig. 135.

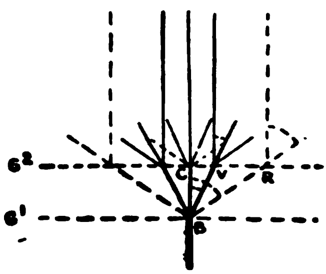


Fig. 136.

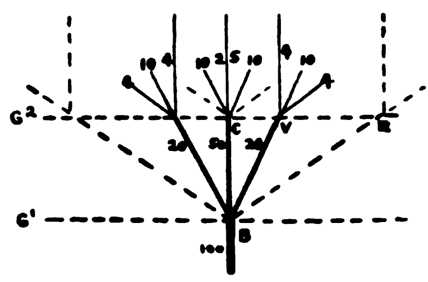


Fig. 137.

And as this reasoning applies equally for rays of all colours and for diffracted rays of any order, it is clear that they *all* issue parallel to one another, the only difference being in their distance from the central or dioptric ray. This distance from the central ray for diffracted rays of different colours is, as will be seen, strictly proportional to their wave-length, and the peculiarly interesting feature presents itself that this proportionality is independent of the distance separating the two gratings; for, as may be seen in figs. 136 and 137 (in which the violet rays V are represented by ordinary and the red rays R by dotted lines), the ratio of C V to C R does not depend on the

position of the second grating, but solely on the angles C B V and C B R. Means are therefore at hand—

1. To obtain parallel rays of light of different colours, spaced in accordance with their wave-length, precisely as occurs in the back focal plane of the objective proper, in the Demonstration Microscope, where the diffraction is caused by the object-grating itself.

2. To vary the width between the central ray and the diffracted ray of any order, without disturbing the parallelism of any of the rays, so that this width can be made the same as if the rays had been diffracted by the object.

That the dioptric and diffracted rays of any one colour will be capable of interference in the one case, just as in the other, is obvious, for in both cases they have been derived from the same source.

But two points of difference shonld be noticed—

1. In the case of the Microscope the relative intensity of the dioptric and the diffracted beams in the back focal plane of the Microscope depends upon the pitch of the *object*-grating.

In the method under consideration not only do the relative intensities of the dioptric and diffracted beams depend upon the pitch of the particular gratings used, but they vary in quite a different ratio. For, suppose for a moment that the violet ray impinging on the first grating has an intensity 100, and that the relative intensity of the dioptric and diffracted ray of the first order is as 50 to 20 when it has passed the first grating, then, when the rays pass the second grating, the components of the same, parallel to the incident ray have a relative intensity of 25 to 4. This is seen on reference to fig. 137, in which the intensities of the rays are written alongside. It is evident that the parallel components emerging from the second lens are diminished in intensity, according to the square of the rate at which they are diminished on emergence from the first grating.

2. In the Microscope the diffracted and the dioptric rays from an object point on the axis of the instrument arrive in the back focal plane in the same phase, because the optical path-length is the same. In the double-grating method the phase differs according to the difference in the path-length between B C and B V (fig. 136), which varies according to the distance between the gratings.

These two points of difference are got rid of by utilising in both instances only the two diffraction bands of the first order, i.e. the one on the left and the one on the right of the central beam. The central beam itself is blocked out by means of a stop placed between H H^1 and T T (not shown in fig. 134).

The result of the experiment * was that a grating structure with perfectly sharp black and white lines was seen exactly as if it had proceeded from the object grating in the ordinary way, so that it seemed at first as though Abbe's laws referred to above had been circumvented. But the idea was easily dispelled, as the appearance of structure remained just as before, on rotating the object-grating on the stage, and it was then found that it remained when the object-grating was removed altogether.

So far as the Microscope image was concerned, these experiments had a negative result: they had merely been an object-lesson as to the correctness of Abbe's laws as to resolving power and the nature of the image, inasmuch as they showed what difficulties beset the path of an attempt at evading them, even in so artificial a manner as the one described. They had led, however, to a simple way of producing achromatic interference bands which might be termed the "double grating method," and which the author was hopeful might be found of practical utility in other directions, in view of the convenience of being able to use white instead of homogeneous light and of the facility with which the spacing of the bands could be varied.

* Detailed particulars are given in the paper of the apparatus, the method of performing the experiment, and the precautions necessary to avoid failure.

Possible Directions of Progress in Optical Glass.

By *Walter Rosenhain, B.A. B.C.E.*

The author thinks there ought to be no slackening in the demand for further advance in optical glass. The progress due to Schott and Abbe did not in all probability exhaust the possibility of further useful optical material, and a wide extension of the available range would be likely to lead to great advances in optical systems.

The optical constants, such as the refractive index, of the glasses at the opticians' disposal at present were confined within distinctly narrow limits, and there was probably some physical fact to account for this.

Reasons are given for supposing that all fluids may be made to solidify in a vitreous amorphous state or in a crystalline state, according to the way in which the solidification is allowed to take place—theoretically it was a question of the rate of cooling and of the absolute pressure. With glasses having extreme optical properties, it was found that the tendency to crystallisation increased, and the methods are discussed by which this tendency may up to a certain point be overcome. But a definite limit is soon reached owing to the impossibility of fulfilling in practice the theoretical conditions. Another limit was imposed by the fact that glasses of extreme optical properties were also of the nature of active chemical agents, both in the fused and in the ordinary solid condition—in fact, a large number of glasses having most desirable properties had to be eliminated from this cause. Owing to these considerations, the author draws the conclusion that any considerable extension of the range of available optical glasses is not likely to be made on lines at all analogous to those pursued in the production of glasses, but that the most promising direction of progress was to be found by accepting the limitations discussed, and in fact taking the line of advance indicated by the most serious of those limitations, viz., the tendency to crystallisation. The object, then, to be aimed at was the production of crystals of composition and properties suitable for optical uses. The task, though exceedingly difficult, should not be more so than was the problem of producing homogeneous optical glass in large masses to the men who attacked that problem a century ago. The optical behaviour of the same substance in the vitreous and crystalline condition always differed greatly. The fact was known in the case of silica, and had been found in a marked degree in experimental glasses produced by the author, having a chemical composition identical with that of certain minerals. For that reason the author emphasises that he does not advocate attempting to get suitable crystals by the "devitrification" of extreme optical glasses, nor of novel glasses by imitating the composition of minerals with promising optical properties. What was necessary was to proceed by studying the conditions to be fulfilled by a crystalline material for optical purposes. The need for transparency and exclusion of all colouring oxides ruled out the great majority of natural minerals. Transparency likewise necessitated that the crystals should be of sufficient size, as crystalline aggregates were useless. Double refraction was objectionable, therefore they were restricted to materials which crystallise in the regular system. To investigate the optical properties of these, a beginning might be made by a detailed study of the optical properties of natural minerals. From a table given, which shows some of the optical properties and chemical composition of natural minerals, taken from Rosenbusch's "Hülfstabellen zur mikroskopischen Mineralbestimmung in Gesteinen," it would be seen that a very considerable extension of optical properties would be made available by artificial production of similar materials in a suitable form. Suggestions are then made, how intermediate forms, extreme forms, and colourless analogues of the

coloured minerals, might possibly be produced. The formation of large crystals is then discussed in connection with the work of Tammann, and, finally, the production of large crystals from aqueous solutions, the formation of crystalline substances insoluble in the liquid present, by gradual chemical action between dissolved bodies, and the formation of crystalline bodies by deposition from the gaseous state, are touched upon. In the study of the nature and mode of production of large mineral crystals might well lie the key to further progress in optical materials.

The Mechanical Design of Instruments.

By *Walter Rosenhain, B.A. B.C.E.*

This paper is a plea for the contention that in a scientific instrument appearance should be altogether sacrificed to utility. A well-made and well-designed machine tool was the ideal prototype of a scientific instrument. There was frequently a tendency to carry refinements requisite in special cases into general use, which often resulted in a loss of mechanical strength and rigidity.

The Microscope comes in for a full share of criticism.

A Simple Pattern of Michelson Interferometer.

By *Herbert Stansfield, B.Sc.*

Working instructions are given for making in a simple and comparatively inexpensive way an interferometer, with which many educational experiments can be carried out. A special feature of the instrument is the mounting of the various parts on geometric bearings.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Number of Chromosomes.‡—Th. Boveri finds that in Echinoids an abnormal number—plus or minus—of chromosomes in an ovum or in a blastomere persists, unless further abnormality sets in, unchanged from one cell-generation to another, on to the gastrula stage, and probably further. There is no regulation restoring the normal number. What was shown to obtain in *Ascaris* holds good for Echinoids.

In such cases the chromosomes, abnormal as to their number, have their typical volume, and the size of the nucleus is directly proportionate to the number of chromosomes. The size of the larval cells is a function of the amount of chromatin, and the cell volume is directly proportionate to the number of chromosomes. The number of larval cells is inversely proportionate to the amount of chromatin or the number of chromosomes. The proportion of the total protoplasm of a larva to the total mass of chromatin is constant. Given equal amounts of chromatin, the number of larval cells is proportionate to the protoplasm-mass of the egg. By regulating the number of cell-divisions, the organism regulates the proportion of chromatin to protoplasm. Within limits the normality of development is independent of the number of chromosomes. But it is not merely the quantitative mass of chromosomes which has to be considered; there must be a representation of the different kinds of chromosomes, if there is to be normal development.

Experiments on Cytoplasm of Amphibian Ovum.§—A. Gurwitsch has shown the power that the cytoplasm has of reconstituting itself after

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This Section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Jenaische Zeitschr. Naturwiss., xxxix. (1905) pp. 445–524 (2 pls. and 7 figs.).

§ Verh. Anat. Ges., 1904; Anat. Anzeig., xxv., Ergänzungsheft, pp. 146–52 (6 figs.).

disturbance and injury. After rotation the centrifugal effects are seen in a regular layered disposition of enchylema, thick amorphous plasma, and yolk-plates. The cytoplasm must therefore be more or less fluid. If there were a reticular meshwork between the yolk-plates there would be traces of its disruption, but there are none. After the cytoplasm has been resolved by centrifugal movement into its components, there is a new organisation to a state like that of a yolk-free germinal disc, finely alveolar in Bütschli's sense. This structure cannot be the essentially vital one—the indispensable physical architecture—for the experiments show that it is the result of a still finer ultra-microscopic organisation.

Formation of Centrosomes in Enucleated Egg-Fragments.*—Naohidé Yatsu has experimented with the eggs of the Nemertean, *Cerebratulus lacteus*. When subjected to the action of a solution of $CaCl_2$, enucleated fragments of unfertilised eggs, obtained by cutting the eggs singly at the metaphase of the first maturation mitosis, develop true asters containing central bodies. The corresponding nucleated fragments show the typical maturation spindle. Cytasters (i.e. asters unconnected with nuclear matter) do not, however, appear in enucleated fragments from unfertilised eggs before the fading of the germinal vesicle. The central bodies of the cytasters developed in enucleated fragments are centrioles identical in structure with those in the nuclear asters of whole eggs similarly treated. Centrioles, therefore, can be produced *de novo* in the matured cytoplasm, i.e. after the dissolution of the germinal vesicle.

Ovum of Lamprey.†—W. Lubosch has made a detailed study of the ovum of *Petromyzon planeri*, with especial reference to the formation of yolk, the egg-envelopes (vitelline membrane or oolemma and zona pellucida or radiata), the follicular epithelium and its metamorphosis, the theca folliculi, the germinal vesicle, and its changes. His observations on the rôle the follicular epithelium plays in yolk-formation and its final disappearance by a sort of inflammation are of great interest. In regard to the maturation, it is noted that it differs markedly from that in Amphibians, Selachians, and Teleosts. It is more like that of many invertebrates. The directive chromosomes arise from a large unified nucleolus.

Passage of the Mammalian Ovum into the Fallopian Tube.‡—Ulrich Gerhardt discusses numerous concrete cases, and points out that there are several different ways in which the passage of the ovum into the tube is secured. The simplest is an enlargement of the receptive surface, the infundibulum tubæ, in proportion to the ovary. This is seen in Monotremes, Marsupials, and Cetaceans. The second and most frequent arrangement is that a portion of the peritoneum of the tube is utilised as a common envelope for infundibulum and ovary, forming a bursa ovarii, as in Insectivora, Chiroptera, Artiodactyla, Rodents, and Carnivora. A third method seems to be confined to the horse, and depends on a reduction of the ovulating surface in proportion to the in-

* Journ. Exp. Zool., ii. (1905) pp. 287–312 (8 figs.).
† Jenaische Zeitschr. Naturwiss., xxxviii. (1904) pp. 673–724 (1 pl., 4 figs.).
‡ Op. cit., xxxix. (1905) pp. 649–712 (33 figs.).

fundibulum, to which the germinal surface is at the same time approximated. In Bradytheria, Manitheria, platyrrhine monkeys, anthropoid apes, and man, none of these three methods can be said to be followed. Here a number of factors co-operate, but in what precise way we do not yet know—the erectility of the fimbriæ, their active muscular movement, the ciliary currents of the tube epithelium, and the configuration of the vicinity of the ovary.

Vitellogenous Layer and Mitochondria in Ova of Mammals.*—O. van der Stricht finds that the vitellogenous layer seen in the ova of guinea-pig, bat, man, etc., includes an aggregate of mitochondria, chondromites, and even pseudo-chromosomes, which are morphologically comparable to the mitochondrial body described by Meves in spermatids.

Spermatozoa of Invertebrates.†—G. Retzius points out that we know only a few of the invertebrate types of spermatozoa. Among Lamellibranchs, for instance, those of *Anodonta* have been carefully studied, but how many more? He has undertaken a study of the spermatozoa of Polychæts and Lamellibranchs. In the former he found two smooth refractive spheres on each side of the insertion of the tail. In bivalves and in the limpet he found the same bodies, 4–10 in number, regularly arranged round the root of the tail. These probably correspond to the "Nebenkern" of v. la Valette St. George, and probably contain the mitochondrial bodies of Benda. During development the head is surrounded by a plasmic envelope with numerous granules, and these collect into the sharply defined regularly arranged "accessory nuclei," whose function in the fertilisation process must be investigated.

Phagocytic Absorption of Spermatozoa.‡—Ch. Pérez describes in captive male newts, kept apart from females, after the sexual period, a process of phagocytic absorption in the testes which is closely similar to the absorption of ova in the females.

Transplantation of Primordia.§—H. Braus has made some striking experiments by transplanting the primordium of a limb from one *Bombinator* larva to another, and watching the development of the graft. He finds in this a method of discovering what powers of organisation are resident in the ingrafted primordium. Thus he finds that blood and blood channels develop autogenously in the ingraft, though the circulation has to wait of course for connection with the blood vessels of the main embryo. There is also self-differentiation of the skeleton, without dependence on the metamerism of the muscular system. The independent development of muscles and nerves was also followed. The author points out that there is in this kind of experiment much opportunity of testing morphological conclusions. It is, in fact, "experimental morphology."

Development of Vascular and Respiratory Systems of Ceratodus.‖ W. E. Kellicott has produced a stately memoir on this subject. His

* Verh. Anat. Ges., 1904; Anat. Anzeig., xxv. Ergänzungsheft, pp. 138–46.
† Tom. cit., pp. 154–6.
‡ P.V. Soc. Sci. Bordeaux (1904) pp. 51–2.
§ Verh. Anat. Ges., 1904; Anat. Anzeig., xxv., Ergänzungsheft, pp. 53–66.
‖ Mem. New York Acad. Sci., ii. Part 4 (1905) pp. 135–249 (5 pls. and 106 figs.).

immediate aim was to test embryologically the evidence, based upon anatomical considerations, for certain supposedly Elasmobranch and Amphibian characters seen in the adult vascular system of *Ceratodus*. The embryological evidence has necessitated continual subtraction from the list of real Elasmobranch resemblances, and continual addition to the list of Amphibian characters. The author gives a useful summary of the Amphibian resemblances, of the characters more or less intermediate between Elasmobranch and Amphibian arrangements, and of the characters peculiar to *Ceratodus*, and he concludes that it is impossible to believe that the Amphibian resemblances seen in *Ceratodus* in the development of the vascular, respiratory, and urinogenital systems, as well as throughout the early processes of development, are of the nature of parallelisms. In the light of their embryology, it is impossible to believe that the Dipnoi and the Amphibians are not closely related, and that they have not travelled for a time along the same path at some period during their history.

Development of Olfactory Organ of Lamprey.*—W. Lubosch gives a full account of the development and structure of the larval olfactory organ in *Petromyzon planeri*, and follows its metamorphosis and the development of the rudimentary olfactory sacs. He shows that the so-called "septum" is foreign to the primitive anlage of the olfactory organ, being really a region of the dorsal wall of the nasal passage which is imported into the complex of the olfactory organ proper. The formation of the so-called "folds" is due to the formation of new olfactory sacs. It is probable that the so-called "glands" appended to the olfactory sacs are degenerate portions of the olfactory organ, perhaps hints of an ancestral distal extension. The author maintains after full discussion that a paired element is pre-formed in the unpaired olfactory plakode, and that the larvæ pass through a "protamphirrhinal" and a "mesamphirrhinal" stage until a "metamphirrhinal" condition is attained. He also contends that the olfactory mucous membrane of the lamprey is to be regarded as the sum of different plakodes, each representing an ancestral sensory organ.

Closure of Nasal Apertures in Human Embryo.†—G. Retzius calls attention to the fact that between the 3rd and 5th month the external nares of the human fœtus are closed by a coherent epithelial tissue which projects from the openings. K. Peter notes that in reptiles and birds the epithelial walls simply fuse together, while in mammals there is proliferation. Other openings—e.g. eye, urethra, rectum—may be closed, as if the delicate epithelium required to be preserved from surrounding fluids.

Sixth Branchial Pouches in Amphibians.‡—A. Greil finds that there is a transitory sixth pair of branchial pouches both in Urodela and Anura, and that it has no relation to the thymus. From the ventral median portion there rises an epithelial bud, first solid and afterwards with a lumen, which becomes the "post-branchial" and

* Jenaische Zeitschr. f. Wiss., xl. (1905) pp. 95–148 (2 pls. and 14 figs.).
† Verh. Anat. Ges., 1904; Anat. Anzeig., xxv., Ergänzungsheft, pp. 43–4.
‡ Tom. cit., pp. 136–7 (1 fig.).

"supra-pericardial" bodies. The post-branchial bodies of amphibians are directly homologous with those of reptiles, but only serially homologous with those of birds and mammals.

b. Histology.

Chromidial Apparatus of Actively Functioning Cells.*—R. Goldschmidt comes to the following conclusions: (1) Every animal cell is essentially bi-nucleate; it contains a somatic and a propagative nucleus. The first has to do with somatic functions, metabolism and movement, and may be called the metabolic or kinetic nucleus. The other contains especially the hereditary substances, and has the power of producing another metabolic nucleus. (2) The two kinds of nucleus are usually combined in an amphinucleus. The separation occurs in varied degrees. A complete separation of the two is rare; most frequently there is a separation into a nucleus predominantly propagative, but still mixed, the cell-nucleus in the ordinary sense, and the main mass of the somatic nucleus, to wit, the chromidial apparatus. (3) Complete separation of the two nuclei is seen in some Protozoa, and during the oogenesis and spermatogenesis of Metazoa. (4) In tissue-cells the separation may not be noticeable, as in most cells which are not functioning actively, as also in mature egg-cells. But two kinds of chromatin, idio-chromatin and tropho-chromatin, may be detected. In other cases the elements of the somatic nucleus form a chromidial apparatus in the plasma (cytomicrosomes, mitochondria, chondromites, accessory nucleus, etc., etc.). (5) Cells with only a propagative nucleus (e.g. gametes of Protozoa), or with only a somatic nucleus (e.g. residual body of Gregarines, some muscle cells), may also occur.

Ergastoplasm and Mitochondria.†—P. Bouin has based a number of general conclusions on a study of the seminal cells in *Scolopendra cingulata*. He maintains that the cytoplasmic differentiations described in the male and female sex-cells of various organisms, under the names pseudo-chromosomes, central capsules, spicules, chrondriomites, mitochondria, and ergastoplasmic filaments, are homologous formations. To these, too, are related the "bâtonnets" of the accessory nucleus, the archoplasmic and archiplasmic loops, and the kinoplasmic filaments.

Intra-Epithelial Glands.‡—M. Nussbaum directs attention to Citelli's § description of intra-epithelial glands. But these were first described by Nussbaum (1883) in the gullet of the slow-worm.

G. Seiffert ‖ has, at Nussbaum's request, studied the glands in the ureter of the horse. There are no unbranched simple glands in the epithelium, such as Hamburger ¶ reported. The glands in the upper third of the ureter are branched tubular glands.

Secretory Function of Nucleus of Hepatic Cells.**—T. Browicz brings forward additional evidence in support of his previously stated

* Zool. Jahrb., xxi. (1904) pp. 41–140 (6 pls. and 16 figs.).
† Arch. Zool. Exp., iii. (1905) pp. 99–132 (2 pls.).
‡ Anat. Anzeig., xxvii. (1905) pp. 121–2.
§ Op. cit., xxvi. (1905) p. 480.
‖ Op. cit., xxvii. (1905) pp. 122–5 (3 figs.).
¶ Arch. f. Mikr. Anat., 1880, No. 17.
** Bull. Internat. Acad. Sci. Cracovie, 1905, No. 3. pp. 250–3 (1 pl.).

conclusion that the nucleus has an active rôle in the process of secretion. Thus he emphasises the fact that vilirubin appears in the form of crystals in the nuclear parenchyma.

Nervous System of Anodonta, Distaplia, and Synapta.* — A. Bochenek, using Apáthy's gold method, has made a histological study of the nerve-cells and glia-cells in these animals, with especial reference to the neuro-fibrils.

Study of Fierasfer.†—L. Bykowski and J. Nusbaum continue their study of this interesting fish, describing the minute structure of the skin and integumentary sense-organs, and also the vexillum and caudal appendage (of the larval forms) which undergo a peculiar degeneration and disappear.

c. General.

Intra-Organismal Selection.‡—Cecil B. Crampton seeks to apply, as Roux and others have done, the selection-idea to intra-organismal conditions, to the inter-relations of cells and parts of cells. "If we have two sets of qualities derived from the two parents, and if, as modern research indicates, these qualities are apposed in sexual transmission, there is a possible mechanism by which only those properties in the germ-cell shall be transmitted, which are the couples of those properties in the body which have been successful in adaptation to their surroundings. These latter must, in the dual personality, either destroy or render latent the corresponding properties derived from the other parental gamete. It might be that the one is rendered latent, and the other dominates the metabolism of the cell, and as to which becomes dominant would depend largely on the external environment in the delicate adjustment of the organism to the surroundings. . . . It may be that there is perpetual struggle for dominance in the metabolism of the cell; that the environment throws the balance of the dominance to one side or the other; that products of the dominant activity in the form of enzymes or the like render the other half latent and gradually suppress it; that such emanations may react upon the germ-cells; and that heredity would follow slowly upon change in the individual under changed conditions of life." The hypothesis advanced in this paper is but a carrying of natural selection into the tissue-cells as individuals, which work in a kind of symbiosis in their complex relations to one another.

Comparative Anatomy and Physiology of the Eye.§—Kalt is the author of an encyclopædic account of the comparative anatomy and physiology of the optic apparatus both in Invertebrates and in Vertebrates.

Origin of Lungs.‖—A. Goette returns to the question of the homology between lungs and swim-bladder, and adheres to the view which

* Bull. Internat. Acad. Sci. Cracovie, 1905, pp. 205–20 (1 pl. and 2 figs.).
† Tom. cit., pp. 169–98 (15 figs.).
‡ Proc. R. Phys. Soc. Edinburgh, xvi. (1905) pp. 62–75.
§ Encyclopédie française d'Ophtalmologie, Paris, 1905. See Journ. de l'Anat. Physiol., xli. (1905) pp. 441–3.
‖ Zool. Jahrb., xxi. (1904) pp. 141–60 (6 figs.).

he advanced in 1875 that the lungs of Amphibians are derivatives of the posterior branchial pouches.

In the Ammocoete there is a progressive degeneration of the posterior branchial pouches; they become small gill-less cæca of the gut, and sometimes entirely disappear, leaving the sixth pair exceedingly like the rudiments of the lungs in Amphibians. In recent Enichthyes no such form of degeneration is seen, for the branchial pouches from the second onwards are simple clefts whose only change is that they close and disappear. But in the larvæ of anurous Amphibians distinct branchial pouches re-appear, and just behind the last pair lie the primordia of the lungs, which look exactly like the rudimentary posterior branchial pouches of the lamprey. By these and other arguments Goette supports his conclusion that the first true lungs appeared in the Enterobranchia, and directly from modified branchial pouches.

Hyperdactylism.*—E. Ballowitz points out that there are two rival interpretations of the occurrence of supernumerary digits. Thus Darwin interpreted it as atavistic, as a reversion to an unknown polydactylous ancestor, while others have interpreted it as teratological, due to a splitting of the normally single primordium of a finger or toe, the splitting being traced to irregularities in the amnion. The amnion may be too small, it may show thickenings or fusions, folds and strands. Ahlfeld found an amniotic thread on the splitting region of a double thumb. Ballowitz has studied the musculature and skeletal parts of four fine cases of hyperdactylism in man, and his conclusion is that the state of the muscles, tendons, and bones supports the splitting theory, and is wholly against the atavistic theory.

Evolution of Mammals.†—Marcellin Boule replies to M. Depéret's recent attack on palæontological methods. He says that the critic has misrepresented the facts, e.g. in supposing that palæontologists now believe that the modern horse is the product of a direct filiation beginning with *Palæotherium*, and passing through *Anchitherium* and *Hipparion*. On the contrary, this view was abandoned by most palæontologists almost a quarter of a century ago; *Palæotherium* and *Hipparion* are not regarded as direct ancestors of *Equus*, but as the dwindling terminations of two lateral branches.

Is Rabies Transmissible from Mother to Offspring?‡—D. Konrádi points out that placentar transmission has been securely proved in anthrax, pneumonia, typhus, pyogenic coccus, recurrent fever, variola, malleus, syphilis, and tuberculosis. He has experimented with the virus of rabies introduced into pregnant guinea-pigs and rabbits, and he has satisfied himself that there is transmission from the mother to the fœtus, with some attenuation in the process.

Pancreatic Bladder in Cat.§—W. S. Miller has found four cases of a pancreatic bladder in the domestic cat. In the last discovered case the pancreatic bladder occupies a special depression to the left of the gall bladder in the quadrate lobe; it is separated by a very thin double-

* Verh. Anat. Ges., 1904; Anat. Anzeig., xxv., Ergänzungsheft, pp. 124–35 (3 figs.).
† Comptes Rendus, cxl. (1905) pp. 1662–4.
‡ Centralbl. Bakt. Parasitenk., xxxviii. (1905) pp. 60–5.
§ Anat. Anzeig., xxvii. (1905) pp. 119–20 (1 fig.).

walled septum from the gall bladder; its duct joins the splenic division of the pancreatic duct.

Male Genital Organs in Sloths.*—Rémy Perrier has investigated the genital organs in *Cholœpus didactylus* and *Bradypus cuculliger*. The testes remain abdominal. There is no connection between them and the inguinal region; there is no inguinal fold or inguinal ligament. It seems probable that the sloths diverged from the primitive Mammalian stock before the *descensus testiculorum* had begun to occur. The pangolin and *Orycteropus* which have inguinal testes, have no near relationship with the American types.

Poison in Viper's Eggs.†—C. Phisalix finds that the active principles of the poison of *Vipera aspis* are present in the ova from oogenesis onwards. It is probable, he says, that other specific substances pass from the blood to the ova, and have their chemical rôle in ontogenesis.

Gadow's Hypothesis of Orthogenetic Variation in Chelonia.‡—R. E. Coker has examined nearly 250 specimens of the diamond-back terrapin (*Malaclemmys centrata*), and finds no evidence of "orthogenetic variation" in the sense that there is normally in the individual life-history a progressive reduction in the number of scutes. A study of a small number of specimens of *Thalassochelys*, on which Gadow's observations were based, afforded no support for his theory.

Minute Structure of Gecko's Foot.§—H. Schmidt has re-investigated this interesting problem. The lappets, arising from scales, which lie in a single or double row on the under side of the toes, bear on their anterior third a thick cushion of very regularly arranged, extremely delicate, hairs or bristles, with minute flat ends. These hairs occur in tufts, which are regularly grouped in fours. Their relations with the formative epidermic cells are minutely described. The hairs are really derived from modified cell-connections; that is to say they have an intercellular origin.

Below the phalanges there is a blood chamber, or a system of blood chambers, extensions of which are prolonged to the tips of the adhesive lappets. The vein leading from these can be closed by an annular muscular sheath. An erection-apparatus results, so that the terminal surfaces of the bristles fit tightly against the surface of adhesion.

The toe as a whole cannot adhere by atmospheric pressure, for the intervals between the lappets to right and left cannot be closed. The lappet of itself cannot adhere by atmospheric pressure, for it is not in actual contact with the surface to which the Gecko adheres. The capacity of attachment must be in the bristles, and Weitlauer's experiment makes it improbable that they can be fixed by atmospheric pressure. Schmidt suggests that the phenomenon of adhesion is due to electrical forces.

Air-Sacs of Chamæleons.‖—Gustav Tornier gives a full account of the tracheal air-sac, which lies between the larynx and the trachea, and

* Comptes Rendus, cxl. (1905) pp. 1054-7. † Tom. cit., pp. 1719-21.
‡ Johns Hopkins Univ. Circular, No. 178 (May 1905) pp. 1-24 (7 figs.).
§ Jenaische Zeitschr. Naturwiss., xxxix. (1905) pp. 551-80 (1 pl. and 2 figs.).
‖ Zool. Jahrb., xxi. (1904) pp. 1-40 (2 pls. and 6 figs.).

works like a whistle or bag-pipe in producing the characteristic sounds. From the Eustachian tube two other pouches can be inflated so that the head-lappets stand out like forward directed ear-pinnæ. Tornier shows how the three sacs co-operate harmoniously when the chamæleon is excited by the approach of an enemy.

Persistent Segmental Canals in Centrina.*—Joan Borcea notes that, as Semper and Guitel have indicated, there are persistent segmental funnels in *Centrina*. In an adult male he found 25 pairs of nephrostomes.

Habits of the Sculpin.†—Theodore Gill gives an account of the life and habits of *Myoxocephalus scorpius*, one of the most abundant fishes in high northern seas. It is most frequently littoral; it is unsocial, sluggish, and voracious; it seems to feed chiefly on Crustaceans. When taken in the hand it is apt to utter a gurgling sound—a voluntary cry, according to Dufossé.

Information as to fecundation is discrepant, but a legitimate inference seems to be that when the sexual products are fully ripe the sexes may come together, and the ova are fertilised just before or during protrusion, but sometimes there may be some arrest or retardation in passage of the eggs, and then there may be internal fertilisation.

The eggs are discharged about the beginning or middle of winter, or, it may be, not before the beginning of spring. The egg-masses are extruded in the sand or pools among the rocks, or attached to stones, tangle roots, sea-weed, and the like. The males may make a nest of sea-weeds and pebbles for the reception of the spawn, and the male may brood over the mass, clasping it with his pectoral and ventral fins. Two or three months may elapse before any eggs are hatched, but the time required for development depends on the temperature. The sculpin has little economic importance.

Branchiostoma elongatum Sundevall.‡—R. Goldschmidt finds that this species described by Sundevall in 1852 is really distinct, and he gives its diagnosis so far as the old type specimen at his disposal would admit. The most characteristic features are the small size of the mouth, the delicacy of the tentacular apparatus, and the reduction in the size of the whole rostral region. It comes nearest to *Branchiostoma californiense* Cooper.

Zoogeographical Relations of South America.§—G. Pfeffer discusses the reptiles, amphibians, and fishes of South America with especial reference to the question of the former land connections of this continent with Africa and Australia. We cannot do more than state his general conclusion, that there is no need on zoogeographical grounds to assume direct land connections between South America and Africa, or between South America and Australia. In a criticism,‖ A. E. Ortmann maintains that Pfeffer's survey is far too partial and too exclusively palæontological to justify his rejection of the theory.

* Trav. Scient. Univ. Rennes, ii. (1904) pp. 178–80.
† Smithsonian Misc. Collections, xlviii. (1905) pp. 348–59 (11 figs.).
‡ Zool. Jahrb. (1905) Supplement Bd. viii., pp. 407–42.
§ Zool. Anzeig., xxix. (1905) pp. 182–8 (1 fig.).
‖ Amer. Naturalist, xxxix. (1905) pp. 413–16.

Fresh-water Microfauna of Paraguay.*—E. von Daday has done a big piece of work in his report on the collections of fresh-water Plankton made by Professor J. D. Anisito in various parts of Paraguay. The memoir deals with Protozoa, Hydridæ, Nematoda, Nematorhyncha, Rotifers, Crustaceans, Tardigrada, and Hydrachnids; and W. Michaelsen reports on the Naididæ. Altogether about 350 species are discussed, including many new forms.

Pelagic Organisms in Scottish Lakes.†—James Murray points out that Scotland is favourably situated for the study of fresh-water plankton, since it forms a meeting place for the northern and southern zooplankton, the eastern and western phytoplankton. He takes a survey of the characteristic forms. Many of them occupy areas which coincide approximately. Thus *Diaptomus laticeps*, *D. laciniatus*, and the Desmids of the western type, alike extend over the whole of Scotland north of the Caledonian Canal and into the Outer Hebrides; south of the Great Glen they are confined to the west coast and some of the central counties, being entirely absent, so far as is known, from all the eastern counties south of the Moray Firth. All have their eastern limit in some small lochs about the extreme western corner of Aberdeenshire. A prominent feature of the Scottish plankton is the Arctic character of its Crustacea.

Biology at Jena during the Nineteenth Century.‡—Ernst Haeckel recalls some of the illustrious workers in Biology who were connected with Jena during the last century. Starting with Goethe and Oken, he briefly refers to the progress of a hundred years and to the work of men like Emil Huschke, Matthias Schleiden, Oskar Schmidt, Carl Gegenbaur. Biology at Jena has for many years centred in Haeckel himself.

Bibliotheca Zoologica.§—O. Taschenberg has completed the seventeenth instalment of his list of zoological papers published between 1861 and 1880. It deals with palæontological literature.

Tunicata.

The British Tunicata.‖—The first volume of an unfinished monograph on The British Tunicata, by the late Joshua Alder and the late Albany Hancock, has been edited by Mr. John Hopkinson, and the Rev. A. M. Norman writes a prefatory history of the work. The work began as a descriptive catalogue by Alder (finished in 1863), and was enlarged to a monograph by Hancock during the subsequent ten years. Alder died in 1867 and Hancock in 1873, and the unfinished work was left for a time in Huxley's hands. As Huxley was unable to devote time to making a presentable volume out of the manuscripts, they were returned to Hancock's representatives, and have till last year remained in the care of the Natural History Society of Newcastle-upon-Tyne. At Canon Norman's request they were sent for publication to the Ray Society,

* Zoologica, xviii. (1905) Heft 44, pp. 1–374 (23 pls. and 2 figs.).
† Proc. R. Phys. Soc. Edinburgh, xvi. (1905) pp. 51–62.
‡ Jenaische Zeitschr. Naturwiss., xxxix. (1905) pp. 713–26.
§ Bibliotheca Zoologica, II. Lief. 17. Leipzig, 1905, 8vo, pp. 5165–5512.
‖ Ray Society, 1905, xii. and 146 pp. (20 pls.).

and they have been carefully edited by Mr. John Hopkinson. The volume gives an historical introduction, an account of the structure and relationships of the class, and a description of the species (30) of *Ascidia*.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Symbiosis of Hydractinian with a Cephalopod.* — F. Baron Nopcsa describes from the Fayum district of Egypt specimens of the Eocene genus *Kerunia*, which Mayer-Eymar regarded as a Cephalopod, and Oppenheim as a Hydractinian. His view is that *Kerunia* "resulted from a remarkably close symbiosis of a *Belosepia*-like Cephalopod with an encrusting Hydractinian, in which symbiosis went so far that the Hydractinian overtook the labour of building up the primitive shell of the Cephalopod which fixed or controlled to a certain extent the growth of the Hydractinian."

γ. Gastropoda.

Study of the Mud Snail.†—Abigail Camp Dimon has made a study of the habits and reactions of *Nassa obsoleta*. On a dry substratum it prefers shade to direct sunlight; on a damp substratum in diffuse light it moves towards the light. In an aquarium the mud-snails tend to group themselves on the lighter side. The siphon and tentacles are sensitive to sudden changes in the intensity of illumination. The animal tends to move against a moderately strong current, and to rest with its head against the current. It may live four or five days out of water. It eats both animal and vegetable food, but prefers the former; it will not eat unless covered with water. Copulation occurs during the rise of the tide, and is followed by the deposition of capsules, which contain a variable number of eggs. A veliger hatches, which develops in two weeks into a form like the adult. The mud-snail holds its place because of its adaptability to varying conditions, and because no other mollusc entirely competes with it. The only form with which *Nassa obsoleta* is not at present adapted to compete is *Littorina litorea*, and the struggle between them may result in a modification of the range of the former.

Development of Kidney and Heart in Planorbis.‡—O. Pötzsch has followed the history of the mesoderm in *Planorbis cornea* from one of the macromeres onwards, and has traced the development of the kidney, pericardium, and heart, which arise from a common rudiment.

Kruppomenia and the Radulæ of Solenogastres.§—H. F. Nierstrasz gives an account of *Kruppomenia minima*, a new Solenogaster from deep water in the Gulf of Naples. There is a thick cuticle; the spicules are like those of *Proneomenia*, in many layers; a ventral fold extends to the cloaca; the radula is distichous; there are two spherical salivary

* Ann. Nat. Hist., xvi. (1905) pp. 95–102 (1 pl.).
† Cold Spring Harbor Monographs, v. (1905) pp. 1–48 (2 pls.).
‡ Zool. Jahrb., xx. (1904) pp. 409–38 (3 pls. and 10 figs.).
§ Op. cit., xxi. (1905) pp. 655–702 (3 pls. and 7 figs.).

glands; the cloaca has gills; there are copulatory spicules; the cloacal ducts have no appendices. The author also discusses the radula of the Solenogastres, "polystichous" in *Proneomenia*, *Dondersia*, *Proparamenia*, and *Macellomenia*, "distichous" in *Paramenia*, *Ismenia*, *Lepidomenia*, *Echinomenia*, *Dinomenia*, *Cyclomenia*, and *Kruppomenia*. The "polystichous" types include the following forms:—polyserial, with or without a basal membrane (*Proneomenia sluiteri* and *P. vagans*); biserial (*P. australis*); monoserial (*Dondersia festiva*); double comb-like or pectinid (*Proparamenia bivalens*); simple comb-like or pectinid (*Macellomenia palifera*). The possible relationships of these types are discussed.

Morphology of a Solenogaster.*—Harold Heath gives an account of *Limifossor talpoideus*, a burrowing Solenogaster from Alaska. One of the interesting facts which he brings out is that, while all external traces of the foot have disappeared, yet a space in the ventral somatic muscles, the overlying pedal sinus, and perhaps a few gland-cells in the anterior end of the body, point to its former existence. The author discusses some of the objections raised against the inclusion of the Solenogastres among Molluscs. He emphasises with Plate the necessity of using typical members of a group in instituting comparisons and of laying especial stress on the broader features of their organisation. Highly modified Solenogastres do indeed exist, and even in the more primitive forms many characters are without a counterpart elsewhere. Nevertheless as Wirén, Pelseneer, Plate, and others have maintained, the relations of the nervous system, gonad, pericardium, and cœlomoducts are sufficient to stamp the Solenogastres as true Molluscs, and for the present at least to confine them within the class Amphineura.

Kidneys and Gonads of Haliotis.†—R. J. Totzauer finds that the two kidneys are independent; that the rudimentary left kidney has its opening on the left side of the rectum, without a special efferent canal as the right one has; that the left kidney has a reno-pericardial communication as the right one has. The gonad has a special duct communicating with the reno-pericardial duct of the right kidney and thus with the efferent canal, but there is before this another communication between the genital duct and the right kidney, as Tobler has observed in *Parmophorus*.

Salivary Secretion of Snail.‡—A. Gorka has studied the physiological properties of the salivary secretion of *Helix pomatia*. The pure secretion has an alkaline reaction, is free from glycogen, and contains mucin, amylolytic and glycolytic ferments, and invertin. The gland stores up a great quantity of glycogen.

δ. Lamellibranchiata.

New Sensory Organ in Nucula.§—Fred Vlès describes in *Nucula nucula* a paired sensory organ—an epithelial ridge situated at the base of the labial palps, and innervated by a relatively large short nerve from the cerebral ganglia.

* Zool. Jahrb., xxi. (1905), pp. 703–34 (2 pls. and 1 fig.).
† Jenaische Zeitschr. Naturwiss., xxxix. (1905) pp. 525–50 (3 pls.).
‡ Allatt. Közlem Budapest, iii. (1904) pp. 211–36; see Zool. Zentralbl., xii. (1905) pp. 304–5.
§ Bull. Soc. Zool. France, xxx. (1905) pp. 88–90 (2 figs.).

Pearl Oysters.*—James Hornell reports some interesting and important observations on the pearl oyster banks of Ceylon. He is still in search of the adult stage of the pearl parasite. He confirms the theory set forth by Professor Herdman and himself that shell-pearls with no vermean nucleus are especially associated with the attachment surfaces of those muscles which have insertion on the shell, especially the small and comparatively weak levator and pallial muscles. Some remarkable illustrations of the activity of the young pearl oysters are given. The effects of this remarkable restless activity are two-fold: it gives a younger generation great advantage over an older in the struggle for existence, the young ones mounting on the topmost parts of the older ones and intercepting food particles which otherwise would pass to the latter; and it aids them also in finding elevated places of refuge when an influx or disturbance of sand occurs. Attention is called to a remarkable phosphorescent phenomenon, previously witnessed by Herdman, "as if the sea were swept by regularly recurring searchlight rays," at intervals of about two seconds and lasting for an hour, each evening. The cause remains undetermined. The bulk of the report is of course strictly practical.

Arthropoda.

α. Insecta.

Notes on Insect Bionomics.†—V. L. Kellogg and R. G. Bell have made various experiments on silkworms. Alterations in the food conditions show that individuals living through their whole post-embryonic life on the smallest food supply capable of sustaining life, a supply varying from one-fourth to one-eighth of the supply normally used by individuals of the species, do not necessarily become males. Silkworms may be cut off from a food supply nearly seven days before the normal limit of their feeding time, and yet complete their development quite normally. The deprivation of food for from one to four days seems neither to hasten the metamorphosis nor to modify it appreciably, nor to result in the production of a moth of lessened size or lessened fertility. If the larvæ are deprived of food for eight days or more before their normal spinning-up time, they invariably die without forming a cocoon, and in only one case was pupation accomplished. A silken cocoon loses a very small amount, about 4 p.c., of its weight in the first day after its completion, and then loses no further weight. The pupa loses weight slightly but persistently and steadily from day to day throughout its entire duration, the total loss amounting to about 14 p.c. The pupæ of the tent caterpillar (*Clisiocampa*), of the checker-spot butterfly (*Melitæa*), and of the mourning-cloak butterfly (*Euvanessa antiopa*), also lose steadily in weight from day to day, the total loss being from 35 to 65 p.c.

Phylogeny of Insects.‡—Anton Handlirsch makes a statement of his conclusions as to the phylogeny of insects, which result in the following arrangement:—

* Reports from Ceylon Marine Biol. Lab., No. 1 (Colombo, 1905) pp. 1–89 (15 pls., maps, and tables).
† Journ. Exp. Zool., ii. (1905) pp. 357–67.
‡ SB. K. Akad. Wiss. Wien, cxii. (1903), received 1905, pp. 716–38 (1 table).

I. Class—Collembola
- Order—Arthropleona
- „ Symphypleona

II. Class—Campodeoidea
- Order—Dicellura
- „ Rhabdura

III. Class—Thysanura
- Order—Machiloidea
- „ Lepismoidea

IV. Class—Pterygogenea

1. Sub-Class—Orthopteroidea
   - Order—Orthoptera
   - „ Phasmoidea
   - „ Dermaptera
   - „ Diploglossata
   - „ Thysanoptera
2. Sub-Class—Blattæformia
   - Order—Mantoidea
   - „ Blattoidea
   - „ Isoptera
   - „ Corrodentia
   - „ Mallophaga
   - „ Siphunculata
3. Sub-Class—Hymenopteroidea
   - Order—Hymenoptera
4. Sub-Class—Coleopteroidea
   - Order—Coleoptera
   - „ Strepsiptera
5. Sub-Class—Embioidea
   - Order—Embiaria
6. Sub-Class—Perloidea
   - Order—Perlaria
7. Sub-Class—Libelluloidea
   - Order—Odonata
8. Sub-Class—Ephemeroidea
   - Order—Plactoptera
9. Sub-Class—Neuropteroidea
   - Order—Megaloptera
   - „ Raphidioidea
   - „ Neuroptera
10. Sub-Class—Panorpoidea
    - Order—Panorpata
    - „ Phryganoidea
    - „ Lepidoptera
    - „ Diptera
    - „ Suctoria
11. Sub-Class—Hemipteroidea
    - Order—Hemiptera
    - „ Homoptera

Notes on Larvæ of Arpyia Vinula.*—E. Balducci describes the larval stages of *Arpyia* (*Dicranura*) *vinula* and the colour changes. He has given particular attention to the defensive organs, the two caudal appendages, and the peculiar anterior organ on the first segment below the mouth, from which irritant fluid is squirted out.

Influence of Nutrition and Humidity on Lepidoptera.†—Arnold Pictet has made many experiments on the influence of nutrition and humidity in promoting variations. Food that is difficult to digest or absorb inhibits larval development, prolongs the larval period, and shortens pupation. Imperfect pigmentation, in extreme cases albinism, is the result. Insufficient food has the same effect. Rich, abundant, digestible food intensifies pigmentation and promotes melanism. The size is also modified by nutrition. The males vary more than the females. The variations induced by nutrition increase in intensity with each generation, and seem to become transmissible. But after several generations there is a return to the primitive type. Nutrition affects the colours of the larvæ as well as of the imagines, and the larval variations may be cumulative during two or three generations. Nutrition also affects the secondary sexual characters. Bad nutrition leads to an increase in the number of males, but rich nutrition does not increase the number of females.

Humidity in the form of rain or saturated air seems to be a factor in inducing partial melanism. Two exceptional experiments showed a tendency to albinism. The melanistic characters appear along the course of the nervures. There was no evidence of inheritance, but the author emphasises "*la loi de l'accoutumance*," that is to say, the fact that individuals become insensitive to factors which influenced their parents.

Pupal Suspension of Thais.‡—T. A. Chapman describes the intricate process by which the larva and pupa of *Thais* make the girth leave its usual situation and become attached to the nose-hooks.

Numerical Proportion of Mimic to Model.§—Horace A. Byatt notes that in a collection of *Limnas chrysippus* and its mimic *Pseudacræa poggei*, there were 17 of the latter to 367 of the model. This occurrence in considerable numbers of what has hitherto been regarded as the rarest species of *Pseudacræa*, supports the hypothesis that the mimics of this group are Müllerian rather than Batesian. Professor E. B. Poulton adds a note comparing the details of the mimetic resemblance borne by *Pseudacræa poggei* to *Limnas chrysippus* with those of the other great Nymphaline mimic *Hypolimnas misippus* ♀.

Experiments on Bombyx mori.‖—Vernon L. Kellogg finds (1) that there is no regeneration of mutilated or destroyed developing gonads in *Bombyx mori*, even though the organs are destroyed or mutilated as early as just after the second larval moulting; and (2) that the destruction of the primary reproductive organs (ovaries and testes)

* Bull. Soc. Entom. Ital., xxxvi. (1904) pp. 117–22 (1 pl.).
† Mem. Soc. Phys. Genève, xxxv. (1905) pp. 1–127 (5 pls.).
‡ Trans. Entomol. Soc. London (1905) pp. 203–18 (1 pl.).
§ Tom. cit., pp. 263–8 (1 pl.). ‖ Journ. Exp. Zool., i. (1904) pp. 601–5.

before the secondary sexual characters are developed, has no effect on the normal course of development of these characteristics.

Regeneration in Larval Legs of Caterpillars.*—Vernon L. Kellogg finds that the larva of the silk-moth, *Bombyx mori*, has the capacity of regenerating its thoracic and abdominal legs from stumps of these legs, but not from the trunk. That is to say each leg has the capacity to regenerate any distal part from any proximal part, but the body cannot produce a wholly new leg. The regeneration described shows externally not after the first moulting after the mutilation, but after the second moulting, and the regenerative processes are completed with the appearance of the new parts after this second moulting succeeding the mutilation. The small, non-segmented, but movable caudal horn, which has no known function, is not regenerated. It was excised from many silkworms of various ages, and in no case was there the slightest regeneration. This favours the theory of the natural selectionists concerning regeneration, but the regeneration of the legs in an animal which has been domesticated for approximately 5000 years under such conditions as to make the natural loss of legs almost an impossible occurrence, does not favour the selectionist interpretation. "The silkworm offers little aid and comfort to those who would explain regeneration wholly as a phenomenon fostered and maintained by natural selection on a basis of utility."

Urate Cells in Hymenoptera.†—L. Semichon has studied the urate-containing cells which Fabre discovered in 1856. They seem to occur in all Hymenoptera, and the author has investigated them in solitary bees. They appear early in larval life, and increase during the period of activity; they seem to be inactive during the period of quiescence; they increase rapidly when the animal is starved; they are decreasing in the immature adults; their appearance is independent of any animal food.

Luminosity of Luciola italica.‡—N. Passerini has studied the physical nature of the light produced by this insect. The radiations are chiefly orange, yellow, and green rays. Their spectroscopic and other characters are discussed.

Aquatic Glow-Worm.§—Nelson Annandale notes that until recently the Lampyridæ were regarded as purely terrestrial and aerial beetles. He has been led to doubt this, and has found an aquatic larval form twice in Lower Siam, and a second in a tank in the suburbs of Calcutta.

Spermatogenesis of Syromastes marginatus.‖—J. Gross has studied the spermatogenesis of this Hemipteron, and gives a detailed account of it, with critical discussion of the results of other workers. He brings out a remarkable fact, that the small chromosomes in the spermatids are not identical with those of the spermatogonia. They arise from the two originally large chromosomes which are formed during the growth period

* Journ. Exp. Zool. i. (1904) pp. 593–9 (10 figs.).
† Comptes Rendus, cxl. (1905) pp. 1715–17.
‡ Bull. Soc. Entom. Ital., xxxvi. (1904) pp. 181–3.
§ Proc. Asiatic Soc. Bengal, x. (1904) pp. 82–3.
‖ Zool. Jahrb., xx. (1905) pp. 439–98 (2 pls. and 8 figs.).

of the chromatin-nucleolus. They do not take part in the growth and become small chromosomes. As such they appear in the spermatogonia of the next generation. They go through the same modifications as the regular large chromosomes, but pass undivided, as accessory chromosomes, into the spermatids.

Inheritance of Dichromatism in Lina lapponica.* — Isabel McCracken has made breeding experiments with this Chrysomelid beetle. Her object was to observe through several generations the behaviour of the particular differentiating character, *colour*, with the view of testing for this insect Mendel's principles of dominance and segregation. Both sexes are dichromatic; they are easily distinguished by their size; individuals may be mated for life, or males of one brood may be allowed to mate freely with females of another; life habits are adapted to laboratory conditions, and at least five generations may be reared in a single season.

No amount of crossing between the two characters—melanic (B) and brown dotted with black spots (S)—accomplishes any disintegration or breaking-up of either one. In the offspring of a cross between the two characters, either both characters, or only the spotted, may appear. Cross-bred B's, namely B's appearing in a cross between the two opposing characters, transmit B only to the offspring when similars are bred together. Cross-bred S's transmit both opposing characters to the offspring, these likewise transmitting both characters, though bred from similar parents. In the third generation from similar parents, S's appear to breed true. There is here no exact parallelism to Mendelian results, but there are Mendelian features. The character S of S by B parentage behaves like a dominant when mated with S. Character B behaves like a Mendelian recessive in that from its first appearance it reproduces B only.

Bamboo-Beetle and Coffee-Plant.†—L. Boutan shows that a *Xylotrechus*, closely allied to *X. quadrupes*, which inhabits the dry bamboo-stems, is a formidable enemy of the coffee-plant. The planters should, therefore, carefully avoid the use of dry bamboos in their coffee plantations, or should at least steep them in a solution of sulphate of iron.

Sexual Dimorphism in Rat Louse.‡—Günther Enderlein describes a striking instance of sexual dimorphism in *Polyplax spinulosa* of the rat. The males have the normal number of tergites and sternites, while in the females the tergites and sternites of the second to the seventh abdominal segments (excepting the tergite of the third segment) are divided into paired plates one behind the other.

Reactions of the Pomace Fly.§—F. W. Carpenter has experimented with the common pomace or little fruit fly, *Drossophila ampelophila* Loew. He finds, for instance, that the insect moves towards the source of light, but when fatigued it seeks out the least illuminated spot and

* Journ. Exp. Zool. ii. (1905) pp. 117–36 (1 pl. and 3 figs.).
† Comptes Rendus, cxl. (1905) pp. 1654–6.
‡ Zool. Anzeig., xxix. (1905) pp. 192–4 (4 figs.).
§ Amer. Naturalist, xxxix. (1905) pp. 157–71.

turns its head from the light. He also finds that "mechanical stimulation has a kinetic effect, since it induces locomotion."

Injurious Insects in Ireland.*—G. H. Carpenter discusses injurious insects and other animals observed in Ireland during the year 1903, e.g. spotted crane-fly, springtails, flea-beetle, carrot-fly, root-mites, and black-currant mite.

Life-History of Case Bearers.†—Ella M. Briggs describes the life-history of *Chlamys plicata*, one of the Chrysomelid beetles. She pays particular attention to the way in which the larvæ build and enlarge their excrementitious cases. The beetles live on the high-vine blackberry, both adults and larval cases resemble pieces of dung, and the cases have also a striking resemblance to the dormant buds of the alder and to the black fruit of the blackberry. The beetle "feigns dead" when disturbed, and its dull colour and rough appearance make it almost undiscernible to the human eye.

New Genus of Diptera from Falkland Islands.‡—Günther Enderlein describes a new Limnobiid—*Zalusa falklandica* g. et sp. n.—which differs from all known genera in having only two branches in the median nervures, and in the marked reduction of the wings, which are about the length of the thorax.

Histolysis of Muscles on Larval Muscidæ.§—Ch. Pérez confirms Kowalevsky's description of the phagocytic absorption of the larval muscles in Muscidæ. The disruption is complete, affecting both myoplasm and nuclei, and it is wholly due to leucocytic phagocytes.

In the subsequent histogenesis, which is also discussed‖, there is an interesting process of nuclear proliferation, which the author calls multiple direct division.

Catalogue of North American Diptera.¶—J. M. Aldrich has produced a huge catalogue of North American Diptera, based upon Osten Sacken's Catalogue (second edition) published in 1878. Since that date the number of species has doubled; the number of references to previously known species has almost doubled; several families have been monographed or revised, with more or less change of nomenclature; along with this has gone the publication of a multitude of smaller papers, touching every family but one, and the larger part of the genera. Thus great changes appear in the new catalogue.

Specific Peculiarities of External Genital Organs in Sarcopsylla.**—F. Du Roselle describes the penis and annexed structures in *S. carnaria*, and shows that in numerous species of this compact genus, the peculiarities of the parts are most reliable specific characters.

New Flea from Armadillo.††—Günther Enderlein gives another illustration of the specialised character of parasites. *Tolypeutes conurus*,

* Economic Proc. R. Dublin Soc., i. (1904) pp. 249–66 (2 pls.).
† Cold Spring Harbor Monographs, iv. (1905) pp. 1–12 (1 pl. and 11 figs.).
‡ Zool. Anzeig., xxix. (1905) pp. 69–72 (2 figs.).
§ P. V. Soc. Sci. Bordeaux, 1904, pp. 68–70.
‖ Tom. cit., pp. 75–6.
¶ Smithsonian Misc. Collections, xlvi. (1905) pp. 1–680.
** Mem. Soc. Linn. du Nord, xi. (1904) pp. 5–10 (2 pls.).
†† Zool. Anzeig., xxix. (1905) pp. 139–42 (6 figs.).

the 3-banded armadillo has its own peculiar flea, *Malacopsylla tolypeutis* sp. n., nearly allied to *M. inermis* from *Dasypus sexcinctus*, and to *M. androcli* from *Canis griseus*.

Brazilian Tabanidæ.*—Adolpho Lutz begins a systematic account of the Brazilian Tabanidæ, of which he has collected towards a hundred species.

Chironomid Larvæ.†—R. Lauterborn describes (1) Chironomid larvæ with freely movable Trichopteron-like case; (2) peculiar sensory organs on the antennæ of some larvæ (pear-shaped structures with a cage of numerous curved setæ around a central sensory cone); (3) stalked gelatinous cases and cylindrical gelatinous tubes from running water.

δ. Arachnida.

Monograph on the Kara-Kurt.‡—K. N. Rossikov gives a full ethological account of the venomous Spider *Lathrodectus tredecim-guttatus* Rossi, the Kara-Kurt of West Europe, South Russia, and the Steppes. It frequents open, sunny localities, and feeds on insects, Arachnids, Isopods, frogs, young lizards, and even shrews, surrounding its prey with snares. Copulation occurs before the last moult, lasts 30–40 minutes, and often ends in the female devouring the male after he has repeatedly effected insemination at intervals of a few days. The eggs are laid the night after the copulation, and the complex cocoons are smaller with each successive insemination. There are eight moultings, the duration of the process increasing from a few minutes to 24 hours. The length of life does not exceed a year. The female keeps close by her nest, the males keep in the background. Many Ichneumonids help to keep down the numbers, and *Chrysopa*-larvæ were found parasitic in the cocoon. The serious symptoms following the bite are described, but man is not often effectively bitten. The juices of the whole body are poisonous, as well as the venom itself, and the poison has a paralysing effect on the heart and the central nervous system.

Parasitism of Larval Phoxichilidium on Bougainvillia.§—Paul Hallez describes what appear to be larvæ of *Phoxichilidium femoratum* in pyriform sacs—modified hydranths—on *Bougainvillia ramosa*. No other species of Pycnogonid induces so much modification in its host.

Terrestrial Mite adapted to Marine Life.‖—N. Passerini describes a terrestrial mite from the blocks of rock deposited around the base of the tower of Meloria where prolonged immersion is inevitable. The mite, which Berlese has named *Erythræus passerinii* sp. n., probably utilises the air imprisoned in the capillary passages in the rock. In any case it has become adapted to marine life.

Habits and Life History of a Social Spider.¶—N. S. Jambunathan found at Saidapet, Madras, a group of "social spiders" (*Stegodyphus*

* Rev. Soc. Sci. São Paulo, i. (1905) pp. 19–32.
† Zool. Anzeig., xxix. (1904) pp. 207–17 (15 figs.).
‡ Arb. Entomol. Bureau Landw., v. (1904) p. 232 (4 pls., 1 map, and 29 figs.). See also Zool. Zentralbl., xii. (1905) pp. 344–8.
§ Arch. Zool. Exp., iii. (1905) pp. 132–44 (1 pl.).
‖ Bull. Soc. Entom. Ital., xxxvi. (1904) pp. 179–80.
¶ Smithsonian Misc. Collections, xlvii. (1905) pp. 365–72 (1 pl.).

sarasinorum Karsch) living in a sponge-like nest of ramified canals, often attached to branches of trees or to leaves of the prickly pear. The number in a nest varies from 40–100, males and females usually in the proportion of 7 to 1, though sometimes the females are less numerous. A number often co-operate to achieve a definite end, e.g. securing victims; and food is shared without quarrel. The absence of much disparity in size and colour between the sexes, the friendly and communal living of the males and females in the same nest, and the happy, almost affectionate relation that subsists between the sexes, indicate a high order of development. The maternal feeling for the offspring verges almost on self sacrifice.

In an appendix it is noted by Mr. N. Banks that the author seems to be unaware of other records of social spiders, e.g. *Stegodyphus gregalis* from South Africa (O. Pickard Cambridge), *Uloborus republicanus* from Venezuela (Simon).

ε. Crustacea.

Metamorphoses of Hermit Crab.*—Millett T. Thompson has made a study of this interesting life-history. The adult *Eupagurus* has a thorough-going dextral asymmetry. Scarcely any system of organs in the body escapes some modification. However, with the exception of the flexor muscles and arteries of the abdomen, the homologies with other Decapods are clear. But the diagonal muscle bands and the peculiar division of the superior abdominal artery into two trunks are interpretable only from a study of the larva. The muscles are then shown to be a greatly degenerated loop-enveloping system, from which the transversalis muscle has been lost. The arteries resolve themselves into supra-abdominal and a new vessel, primarily derived from the second segmental artery of the right side, and probably peculiar to Pagurids.

The development is concentrated. There are four stages in the zoæa phase, the last of which is a metazoæa. The post-zoæal or glaucothoe phase consists of one stage, which is macruran in general form and from the first presents a mingling of adult and larval characters. Details of this are given.

The metamorphosis by which the structures attain the adult type commences before a shell is taken, and the stimulus of a shell is not necessary for its completion. But the shell is very important in affecting the duration of metamorphoses and for the health of the animal. The anatomical modifications that appear during the glaucothoe stage are, with but one exception, uninfluenced by either the presence, absence, or form of the shell. The exception is found in the retention of rudimentary pleopods on the right side of the body in the sixth stage, though typically at this period appendages should be absent from this side.

There is evidence that hermit crabs show a preference for dextral shells, and the author thinks there is a strong presumption in favour of the view that the asymmetry was, from the first, a result of life in dextrally spiral shells.

* Proc. Boston Soc. Nat. Hist., xxxi. (1903) received 1905, pp. 147–209 (7 pls.).

New Mysid Genus.*—G. Illig describes *Echinomysis chuni* g. et sp. n., captured by the German Deep-Sea Expedition in the Antarctic Ocean and in the Indian Ocean. It is remarkable for its extraordinarily rich covering of spines on the cephalothorax and limbs.

Atlantic Penæidæ and Stenopidæ.†—E. L. Bouvier reports on collections made in the eastern Atlantic. Notable species of Penæids of extreme rarity are *Hemipenæopsis villosus*, *Grimaldiella richardi*, and *Aristeopsis armata*. A very interesting Stenopid is *Spongicola evoluta*, which preserves in a remarkable degree the traces of its phyletic evolution.

New Schizopods.‡—E. W. L. Holt and W. M. Tattersall report on a collection of Schizopods made by Mr. George Murray during the cruise of the 'Oceana' in 1898. They describe two new species, *Katerythrops oceanæ* and *Gnathophausia drepanephora*.

New Cave Isopod.§—E. G. Racovitza describes *Typhlocirolana moraguesi* g. et. sp. n., an aquatic Isopod from the dragon grotto in Majorca. The grotto has a rich and varied fauna, including various Diptera, a Hemipteron, two spiders, a species of *Lithobius*, a terrestrial Isopod, two aquatic Amphipods, a Planarian, and the above-mentioned representative of the family Cirolanidæ.

Female Gonads of Cypridina.‖—A. Ramsch describes the ovary, oviduct, external genital parts, and oogenesis of *Cypridina mediterranea*.

Annulata.

Oligochæta of Lake Baikal.¶—W. Michaelsen contributes the first memoir dealing with the results of Professor A. Korotneff's expedition to Lake Baikal, and describes the Oligochæta. Thirty-six species were found, fourteen of them new. The remarkable feature is that they mostly represent primitive archaic types, phyletically ancient. Thus the genus *Lamprodrilus* is ancestral to all the Lumbriculidæ; *Teleuscolex* is perhaps even older; *Propappus* is at the root of the Enchytræidæ. Lake Baikal is doubtless unique, "a zoological-palæontological museum" in which there still live organisms of ancient days mingled with more modern forms. It is not a relict sea, but a persistent lake of great geological antiquity, which has proved an asylum for many types which have long since disappeared elsewhere. The series of memoirs thus begun deserves hearty welcome.

Annelids of Cette.**—Albert Soulier continues his description of the Annelids of Cette, dealing with the genera *Pygospio*, *Sphærosyllis*, *Grubea*, *Spermosyllis*, *Exotokas*, *Syllis*, and *Polycirrus*.

Phenomena of Asexual Reproduction in Salmacina and Filigrana.††—A. Malaquin finds that asexual multiplication in these types is pre-

* Zool. Anzeig., xxix. (1905) pp. 151–3 (2 figs.).
† Comptes Rendus, cxl. (1905) pp. 981–3.
‡ Ann. Nat. Hist., xvi. (1905) pp. 1–10 (2 pls.).
§ Bull. Soc. Zool. France, xxx. (1905) pp. 72–80.
‖ Zool. Anzeig., xxix. (1905) pp. 133–6 (1 fig.).
¶ Wissensch. Ergeb. Zool. Exp. Baikal-See. Erste Lieferung, Kiew and Berlin. 1905, pp. 1–69 (9 figs.).
** Mem. Sect. Sci. Acad. Montpellier, iii. (1904) pp. 319–74 (12 figs.).
†† Comptes Rendus, cxl. (1905) pp. 1484–7.

pared for by the accumulation in each of the posterior segments of four special histogenetic masses, situated between the muscular bundles and the cœlomic endothelium. At the maximum development, these masses, formed of yellowish cells, distend the rings of the Serpulid and protrude like a hernia into the body-cavity. This histogenetic material occupies precisely the same place as the sex-cells occupy in the sexual individuals. The material for proliferation is homologous with the sexual material.

Integumentary Structures of Sipunculids.*—Marcel A. Hérubel has made a comparative study of the papillæ, spines, and hooks of Sipunculids. A group of hooks never co-exists with a group of spines; all the hooks of any one species belong to the same type; the papillæ are almost *generically* constant; the papillæ and hooks are most developed in species from the warmer waters.

New Species of Echiurus.†—A. Skorikow refers to two specimens of an *Echiurus* obtained in 1902 by the 'Puritan' near Capri, from a depth of 1100–1500 metres or more. Lo Bianco named them *Echiurus pallasi*, but Skorikow doubts if this species occurs in the Mediterranean. An examination of the specimens showed that they differ from *E. pallasi* Pall (or more correctly *E. echiurus* Pall.), e.g. in the relatively large and distinct funnel of the segmental organ.

Blood-vessels of Rhynchobdellids.‡—Emily Arnesen has studied *Branchellion*, *Pontobdella*, *Glossiphonia*, and other leeches with reference to the fine structure of the blood-vessels. She has given particular attention to the dorsal blood-vessel and its valves. The lining of the vessels consists of an internal muscular and a median connective-tissue layer, which is covered externally by cœlomic epithelium (Kowalevsky's "cellules acides"). The muscular layer consists of muscle-cells which are to begin with of the same type as those in the rest of the body. The valves seem to arise as pouch-like invaginations of the corners between the septal lamellæ and the wall of the blood-vessel. It is probable, as Kupffer suggested, that they form blood corpuscles.

Oogenesis of Branchellion.§—Ch. Pérez and E. Gendre report some interesting phenomena in the oogenesis of this specialised leech. In the germinal portion of the ovary the cells are found in groups of two, one within the other. The external cell distends into a sort of shell, the internal cell forms a spherical morula. Among the uniform cells of this morula one becomes central and increases in size. It is merely a cytophore, however, for it is one of the superficial cells that increases greatly in size and becomes the ovum.

Nematohelminthes.

Structure and Relationships of Gordiidæ.‖—Max Rauther concludes from his detailed anatomical study of Gordiidæ that they are nearly related to Annelids. Their structure sheds light on that of

* Bull. Soc. Zool. France, xxx. (1905) pp. 90–97 (2 figs.).
† Zool. Anzeig., xxix. (1905) pp. 217–21.
‡ Jenaische Zeitschr. Naturwiss., xxxviii. (1905) pp. 771–806 (3 pls.).
§ P. V. Soc. Sci. Bordeaux, 1904, pp. 108–9.
‖ Jenaische Zeitschr. Naturwiss., xl. (1905) pp. 1–94 (4 pls.).

Annelids, especially as regards the cœlom and genital organs. There is no possibility of derivation from Platyhelminths or Trochozoa, but there may be some connection with a Scyphozoon-like ancestral type. The completely segmented type of body has arisen from a state with "pseudometamerism" including gonomerism, which began in the common ancestors of the Gordiidæ and the free-living Annelids, either independently or in direct connection with the cyclomeric gonads of Scyphozoa. The segmentation of the mesoderm arose in dependence on gonomerism; while neuromerism and external segmentation are to be regarded as locomotor adaptations.

Monograph on Acanthocephala of Birds.*—L. de Marval follows Hamann in recognising three genera—*Echinorhynchus*, *Gigantorhynchus*, and *Neorhynchus*; he has studied as far as possible for each species, (1) the form, dimensions, musculature, and subcutaneous canals; (2) the form, size, and structure of the eggs; (3) the form and dimensions of the "cou" and "faux-cou"; (4) the rostrum and its hooks. He deals with 32 species, all of *Echinorhynchus*, except *Gigantorhynchus compressus* Rudolphi, *G. mirabilis* de Marval, and *Neorhynchus hemignathi* Shipley.

Platyhelminthes.

Copulation in Cestodes.†—C. v. Janicki describes *Bertia rigida* sp. n. from a species of *Phalangista*, and *Cittotænia zschokkei* sp. n., both from New Guinea. In studying the latter, he found that there is, as the proglottis grows older, an atrophy of the vagina. The facts which he describes lead him to the interesting conclusion that in the copulation the younger proglottides are passive, being practically female, with the testes still undeveloped, while the mature proglottides, though the female organs are in full development, function as males, the absence of a vagina preventing normal reception of sperms. Thus all the ova in the ripe joints are fertilised by sperms received in youth in the large receptaculum seminis. There is no direct communication between the testes and the receptaculum seminis of the same proglottis, so that internal autogamy is out of the question. The insemination of the immature joints of a young strobila, which has no ripe joints, must of course be effected from another older strobila.

New Cestode Larva Parasitic in Man.‡—Isao Ijima describes under the title *Plerocercoides prolifer* g. et sp. n. the larva of a Bothriocephalid (?) found in enormous numbers, especially in the subcutaneous tissues, in a woman from Tokyo. Most of the worms were in capsules, a few were free. The worm has the power of dividing and multiplying within the capsule, and it can also proliferate by budding. It shows a far-reaching structural agreement, especially in the musculature and excretory system, with the Bothriocephalid larva *Sparganum* of Diesing, as well as with Cobbold's "*Ligula mansoni*."

Maturation, Fertilisation, and Development in Zoogonus mirus.§ R. Goldschmidt has studied this Distomid found in the hind-gut of

* Rev. Suisse Zool., xiii. (1905) pp. 195–387 (4 pls.).
† Zool. Anzeig., xxix. (1905) pp. 127–31 (2 figs.).
‡ Journ. Coll. Sci. Univ. Tokyo, xx. (1905) Art. 7, pp. 1–24 (1 pl.).
§ Zool. Jahrb. xxi. (1905) pp. 607–54 (3 pls. and 1 fig.).

Labrus merula. It is very favourable for a study of early stages, since the egg has no shell and has very large cells. We cannot do more than refer to three points. There is no trace of true yolk-cells, and the early nutrition of the embryo must be exclusively from the uterine wall. The enveloping membrane is formed from cells contributed by the equivalent of the yolk-gland. In the maturation there is no pseudo-reduction; there is the normal number (not half the normal number) of chromosomes in the nucleus, and there is separating off of entire chromosomes in the second maturation division.

Oogenesis and Development of Fasciola hepatica.* —W. Schubmann describes the development of the oocytes in the ovarian cæcal tubes, their connection to the wall by a nutritive stalk, their discharge into the oviduct, and the degeneration of a large number into nutritive material. The history of the yolk-cells is followed: 28–30 surround each ovum. The egg-shell arises by direct differentiation from the shell-gland secretion which envelops the ovum and its companion yolk-cells.

Maturation sets in after the formation of the egg-shell, after the egg has reached the beginning of the uterus. Three polar bodies are formed. The spermatozoon enters during the formation of the first polar body. The egg remains in the uterus till the two resting pronuclei are formed; the further changes occur after the eggs are liberated.

Segmentation leads to the formation of a macromere and several micromeres, which divide actively and surround the former. Meanwhile the yolk-cells disrupt within the shell and furnish nutriment for the growing embryo. The ensheathing membrane is of embryonic origin from liberated ectoderm cells, and not a product of the yolk-cells.

Planaria alpina in Belgium.†—L. Fredericq has found this characteristic Alpine Planarian on the plateau of Baraque-Michel, within the Belgian frontier. It is a new acquisition for the Belgian fauna.

Eumesostominæ.‡—Alex. Luther has worked through a large number of these fresh-water Turbellarians, and gives a connected account of their structure. He recognises three tribes: I. Olisthanellida, including the genus *Olisthanella* Voigt; II. Typhloplanida, including *Strongylostoma* Oerst, *Rhynchomesostoma*, g. n., *Tetracelis* Hempr. and Ehrenb., *Castrada* O. Schm., *Typhloplana* Hempr. and Ehrenb.; III. Mesostomida, including *Mesostoma* Oerst and *Bothromesostoma* Braun.

Development of Fresh-water Dendrocœla.§ — E. Mattiesen has studied *Planaria torva* and other forms, with especial reference to the formation and contents of the cocoon, the maturation of the ovum, the changes in the segmentation-nucleus leading on to the first mitosis, and the early stages in development. We cannot do more than refer to one

* Zool. Jahrb. xxi. (1905) pp. 571–606 (2 pls.).
† Bull. Classe Sci. Acad. Belg., v. (1905) pp. 199–200.
‡ Zeitschr. wiss. Zool., lxxvii. (1904) pp. 1–273 (9 pls. and 16 figs.).
§ Tom. cit., pp. 274–361 (4 pls. and 3 figs.).

general conclusion of much interest, that there is no strict definition of germinal layers in the development.

Structure of Carinoma.*—D. Bergendal has made a study of the structure and affinities of this Nemertine. The head shows the typical body musculature, an external circular layer, and an internal longitudinal. The brain lies, as in Heteronemertini, outside the outer circular muscle-layer and inside the outer longitudinal muscle-layer, and not in the middle of a layer, as in *Cephalothrix*. The histology of the head is discussed at length.

The cephalic grooves of *Carinoma* may correspond to the cerebral organs of *Carinella*; the mid-gut has deep pouches, as Bürger reported.

It is impossible to regard *Carinoma* as occupying a position between primitive Nemertines and Hoplonemertini; it is nearer to *Carinella* and the Heteronemertini than to *Cephalothrix*. It probably arose from a form intermediate between Carinellidæ and Heteronemertini. The memoir also includes some discussion of *Carinella annulata* and *Hubrechtia*.

Incertæ Sedis.

Ptychodera erythræa.†—Ch. Gravier describes this species from Djibuti, on the Gulf of Aden.

Echinoderma.

Regeneration in Linckia diplax.‡—Vernon L. Kellogg has studied the regeneration of this sky-blue starfish, conspicuous on the surface of the coral reefs guarding the harbour of Apia (Samoa). There seems to be no doubt of the capacity of an arm torn off at some distance from the disc to regenerate a complete new animal from its proximal surface. In a segment of an arm regeneration may proceed at both mutilated ends. Two figures show an arm regenerating a disc with a new mouth and two madreporites (the normal number in this species).

Merogonic Development of Sea-Urchin Ova.§—M. Krahelska recalls the fact that the first experiments on merogony were made by Rostafinski ‖ in 1877. She has herself worked with the ova of *Psammechinus microtuberculatus*, and finds that normal segmentation occurs only in fragments which have rounded themselves off after separation. Two forms of abnormal development are distinguished, which seem to be due rather to the alteration of the cytoplasmic organisation than to the absence of a female pronucleus. The rounding off, the central localisation of the mitotic figure, and autotomy of much altered portions of the cytoplasm, are all expressions of the self-regulating capacity of the egg-fragment, which seeks to reconstitute normal relations.

Internal Secretion in Gonads of Phyllophorus urna.¶—Ach. Russo and G. Polara have studied the peritoneal investment of the genital cæca in this Holothurian. Some of the cells are supporting

* Lunds Univ. Årsskrift, xxxix. (1903) received 1905, Afd. ii., No. 2, pp. 1–87 (2 pls.).
† Bull. Mus. Hist. Nat. Paris, 1905, pp. 46–51 (4 figs.).
‡ Journ. Exp. Zool., pp. 353–6 (6 figs.).
§ Bull. Internat. Acad. Sci. Cracovie, 1905, pp. 49–65 (3 pls.).
‖ "Dividua ovi natura," Acad. Sci. Cracovie, 1877.
¶ Anat. Anzeig., xxvii. (1905) pp. 13–19 (6 figs.).

elements, but others are glandular, and the secretion of the latter passes into the cæcum and collects in a schizocœlic space in the connective tissue between the peritoneal layer and the sex-cells. The material seems to be used by the sex-cells, and probably by the viviparously developed embryos.

New Holothurian from French Coast.*—R. Kœhler and C. Vaney describe *Pseudocucumis cuenoti* sp. n. found near Archachon between 20 and 50 metres. It approaches *P. mixta* from Arctic waters, but differs in the form of the radial pieces of the calcareous ring, in the number of tentacles, and in the distribution of the tube-feet. With the exception of *P. mixta* and this new species, all the known species of *Pseudocucumis* are from Indo-Pacific regions. Another point of interest is that *P. cuenoti* seems to be a transitional form between the genera *Pseudocucumis* and *Phyllophorus*.

Northern Synaptids.†—Hjalmar Ostergren describes *Synapta bergensis* sp. n., *S. decaria* sp. n., *S. inhærens* (O. F. Müller), *Labidoplax buskii* (M'Intosh), *L. media* sp. n., and *Myriotrochus théeli* sp. n., and discusses the value of the various specific distinctions.

Cœlentera.

History of Investigation of Hydroids.‡—M. Bedot continues his painstaking account of researches on Hydroids. The first part brought the record down to 1821, the present part deals with the period from 1821 to 1850. He gives a bibliographical index, a statement of the various classifications proposed, and a list of the species with synonyms.

Polyparium ambulans Korotneff.§—Oscar Carlgren does not believe in *Polyparium ambulans*, and says that any naturalist who works by the seaside for a month or two may find a *Polyparium*-like organism, namely, a separated portion of a sea-anemone, as indeed was suggested by Ehlers in 1887. He gives circumstantial reasons for believing that *Polyparium* was a torn-off and healed-up portion of the most distal region of an Actinian belonging to the family Stoichactidæ. He thinks, therefore, that the remarkable organism which Korotneff described has had its day, and should now disappear from the list of Cœlentera. "We have without *Polyparium* quite enough of zoological paradoxes."

Magellan and Chilian Hydroids.‖—Cl. Hartlaub reports on various collections of Hydroids from the Patagonian coast, the Falkland Islands, Magellan Straits, Chilian coast, etc. He finds undeniable resemblances between the arctic and boreal and the sub-antarctic Hydroid fauna, and has many interesting zoogeographical notes.

Southern Antipatharians.¶—J. Arthur Thomson reports on the small collection of Antipatharians made by the Scottish Antarctic Expedition. Twelve specimens were obtained by the 'Scotia,' representing

* Rev. Suisse Zool., xiii. (1905) pp. 395–400 (6 figs.).
† Arch. Zool. Exp., iii. (1905) Notes et Revue, No, 7 pp. 133–144 (2 figs.).
‡ Rev. Suisse Zool., xiii. (1905) p. 1–183.
§ Biol. Centralbl., xxv. (1905) pp. 253–6.
‖ Zool. Jahrb., 1905, Supplement vi., Bd. 3, Heft 3, pp. 497–714 (1 map and 142 figs.).
¶ Proc. R. Phys. Soc. Edinburgh, xvi. (1905) pp. 76–9.

three species,—*Bathypathes patula* var. *plenispina* Brook, *B. alternata* Brook, and *B. bifida* sp. n. In the new species, a slender basal piece rises vertically to a height of 15 mm., and then bifurcates into two long branches which extend in opposite directions for about 16 cm. The most remarkable feature in the polyps is the length (up to 3 mm.) of the lateral tentacles.

Porifera.

Chilian Sponges.*—J. Thiele reports on the silicious and horny sponges of Plate's collection, including 80 species many of which are new.

Protozoa.

Genus Amœba.†—E. Penard discusses the genus *Amœba*, which, in spite of acknowledged difficulties, he maintains to be "autonomous" and separable from the numerous pseud-amœbæ which are familiar to all naturalists. Too many young forms and mere phases have been thrown into the "Pot aux amibes," but Penard does not despair of the genus—"genre embrouillé, véritable chaos peut-être, mais chaos dont on sortira quelque jour."

Protozoa in Human Fæces.‡—A. Castellani describes *Nyctotherus africanus* sp. n., in the fæces of a Baganda native affected with sleeping sickness. The most interesting feature of the parasite is in the macronucleus, which is very large, rounded in shape, and has, as Schaudinn described in *Nyctotherus faba*, its chromatin collected in four large masses at the periphery. In a case of chronic dysentery, Castellani found *Entamœba undulans* sp. n., an oval or roundish form without flagella, with one pseudopodium at a time, and with a continuous rapid undulatory movement from one extremity to the other, this being due to the presence of an undulatory membrane.

Radiolarian Skeleton.§—V. Häcker points out that the mechanical interpretation of the skeletal structure of Radiolarians requires to be supplemented by a biological interpretation showing the functional import of the various architectural arrangements. It is this latter mode of interpretation which he has very convincingly worked out in the present memoir. Thus, to take a particular case, he shows how the three-jointed elastic system, illustrated by the radial spines of *Auloscena verticillus*, is in its minutest details adapted to the function of supporting the sarcode-membrane. The candelabra-like arrangement of the appendicular parts is adapted to keep the strongly developed sarcode-membrane at a uniform distance from the lattice-work of the shell, while in *A. pelagica* the structure of the skeleton is adapted to the finger-like evaginations and corresponding deep depressions of the soft body. In the same genus we find different adaptations to the conditions of the deep cold abysses, and to the planktonic conditions of the warm surface water. It is suggested that the biological interpretation of the Radiolarian skeleton,

* Zool. Jahrb. (1905) Supplement vi., Bd. 3, Heft 3, pp. 407–96 (7 pls.).
† Rev. Suisse Zool., xiii. (1905) pp. 401–9.
‡ Centralbl. Bakt. Parasitenk., xxxviii. (1905) pp. 66–9 (5 figs.).
§ Jenaische Zeitschr. Naturwiss., xxxix. (1905) pp. 581–648 (28 figs.).

which implies a knowledge of the relations between the skeleton and the soft body, will be of service in reference to the architecture of Hexactinellid sponges. In an appendix Häcker gives an account of the Phæosphæria of the "Valdivia" and the "Gauss."

New Hæmatozoon in a Squirrel.*—J. J. Vassal describes from *Scuirus griseimanus* from Annam a new form of *Hæmamæba*, which closely approaches *Hæmamæba malariæ* of man. It may be that the squirrel takes man's place in the life-cycle of the malaria parasite. But in Vassal's experiments the *Hæmamæba* from the squirrel was not inoculable into man, macaque monkey, rabbit, guinea-pig, or squirrel.

Microsporidian in Crabs.†—Ch. Pérez describes the structure and life-history of a new Microsporidian (*Thelohania mænadis* sp. n.) which infests the muscles of the shore crab (*Carcinus mænas*). It seems to affect the nutrition of the crab, to lead to the suppression of a moult, and thus to favour the growth of epizoic organisms on the carapace.

New Blood Parasite of Frog.‡—James Stebbing, jun., describes a large worm-like parasite, which he calls *Karyolysus clamatæ*, from the blood of *Rana clamata*. It is able to enter and leave the blood corpuscles with the greatest ease and rapidity, and always mutilates the corpuscles badly in so doing. It seems to attack both the leucocytes and the erythrocytes, but shows a marked preference for the latter.

Trypanosome of Dourine.§—A. Lingard discusses this parasite of horses. A stallion or mare usually contracts the disease during coitus. In the stallion the preferential sites for the development appear to be the extremity of the penis and later its sheath; in the mare the vulva appears to be the usual seat. The Dourine plague—a form of nettle-rash—is described, and the changes that take place in the form of the trypanosome during the persistance of the plague are discussed. Flies can convey the disease to healthy susceptible animals. Certain breeds of horses can maintain the "materies morbi" of Dourine in their systems for periods of from one to four years.

Sexual Reproduction in Actinomyxidia.‖ — M. Caullery and F. Mesnil have studied the life-history of *Sphæractinomyzon stolci* C. et M. a Protozoan parasite of marine Oligochæte, and have observed a conjugation of gametes with some degree of anisogamy.

Trypanosoma Paddæ.¶—M. Thiroux gives an account of the structure of this Trypanosome which Laveran discovered in *Padda oryzivora*. He has successfully inoculated five species of birds, but six others, besides rats, mice and frogs, proved refractory. In the Padda it occurs along with *Halteridium danilewskyi*, but the two are quite distinct, and there must be a double infection.

* Ann. Inst. Pasteur, xix. (1905) pp. 224–32.
† P. V. Soc. Sci. Bordeaux, 1904, pp. 107–8.
‡ Centralbl. Bakt. Parasitenk., xxxviii. (1905) pp. 315–18 (2 pls.).
§ Op. cit., xxvii. (1905) pp. 537–47.
‖ Comptes Rendus, cxl. (1905) pp. 1482–4.
¶ Ann. Inst. Pasteur, xix. (1905) pp. 65–83 (2 pls.).

Spirochæta pallida.* — F. Schaudinn and E. Hoffman announce the discovery of two varieties of *Spirochæta* in venereal lesions. These they name *Sp. refringens* and *pallida*. The former is coarser and stains darkly, and is found in surface lesions, while the latter is more slender and difficult to stain, and is found in primary sores, condylomata, and enlarged lymphatic glands. *Sp. pallida* is actively motile, its movements being undulatory in character. It measures from 4–14 μ in length and is less than ¼ μ thick. The number of coils, which are closely set, varies from 6–14. It is extremely resistant to dyes, Giemsa's Eosin-Azur† mixture being the most effective. Spirochætæ are probably Protozoa, and differ from spirilla in the character of their movements, in the flexibility of their bodies, the possession of an undulatory membrane, and a resting stage. One interesting and important point in connection with their life-history is that a Spirochæta stage is a phase in the cycle of a Trypanosome.

* T. Ziemanni, Deutsche Med. Wochenschr., 1905, No. 18. See also Centralbl. Bakt., 1te Abt. Ref., xxxvi. (1905) pp. 759–61.
† J.R.M.S., 1905, p. 115.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Anatomy of Catalpa Hybrids.*—D. P. Penhallow gives the results of his investigation of the anatomical details of the stem structure of a hybrid *Catalpa* of doubtful parentage (the so-called Teas hybrid), and three well-known species. He concludes that hybrid characters are expressed in the structure of the vascular cylinder as well as in external alterations of form and colour. Also that the Teas hybrid is the product of a cross between *C. Kæmpferi* and *C. bignonioides*, and that *C. speciosa* has played no part in its production. This confirms the conclusion already reached by Professor Sargent on the basis of external morphology. The dominant characters of the hybrid, as expressed in the internal structure, are those of the Japanese parent as similarly shown in the external characters. The resultant characters are most strongly shown in transverse section, less so in the tangential, and least of all in the radial. The author regards the hybrid as representing a new species comparable to the large number of species of *Crataegus* now recognised by Professor Sargent.

Leaf-Nervation in some Species of Bupleurum.†—H. E. Petersen describes five types of arrangement of the secondary and tertiary nerves in a series of species of this genus, and establishes therein four groups of species. There is considerable doubt, however, as to whether these represent natural groups.

Water-Conducting Systems of some Desert Plants.‡—W. A. Cannon, working at the Desert Botanical Laboratory of the Carnegie Institution, has made a comparative examination of the structure of a number of the native desert trees and shrubs, using individuals growing under normal desert conditions and those which have been more or less irrigated, that is to say, grown in greater or less proximity to water. He finds that branches of irrigated plants are poorer in conductive tissue than branches of the same diameter of non-irrigated plants. The author remarks that this is an unexpected condition and of especial interest in view of the small development of the water-conducting

* Amer. Nat., xxxix. (1905) pp. 113–136 (8 figs. in text).
† Bot. Tidsskr., xxvi. (1905) pp. 343–376 (34 figs. in text).
‡ Bot. Gazette, xxxix. (1905) pp. 397–408 (9 figs. in text).

elements in the non-irrigated forms of the Egyptian-Arabian deserts as given by Volkens. The irrigated plants have a greater absolute transpiration, and form each year a larger amount of wood than non-irrigated plants of the same age; but the composition of the wood is different in the two cases. The irrigated plants form a relatively large amount of non-conductive tissue each year, while the reverse is true of the non-irrigated plants. Hence in stems of equal diameter, but not of the same age, the non-irrigated and older stems have more vessels than the irrigated and younger. The ducts were usually or frequently of greater diameter in non-irrigated stems.

Reproductive.

Megaspore Membrane in Gymnosperms.*—R. B. Thomson has investigated the coat of the megaspore in Gymnosperms. It is present in all except the Taxeæ, where it is almost or entirely absent. It consists of two layers, the outer suberised, the inner of a composite character being suberised in its outer portion and containing cellulose associated with a pectin-like substance in its inner portion. Briefly, it resembles the microspore coat in structure and composition. In the Araucarieæ the suberised outer layer is absent. The forms with the usual type of membrane have a more or less well-developed tapetum, derived from the sporogenous tissue, which is quite distinct from that derived from nucellar tissue. From the relative development of the megaspore coat and of the tapetum, the author concludes that the Abieteæ are the most ancient groups of Coniferales, and the Taxeæ the most recent; that the Taxodieæ and Podocarpeæ are complex, and include both ancient and recent forms; and that the Cupresseæ occupy an intermediate position.

Development in Ovule and Seed of Anona.†—N. Roncati has studied the gametophyte and embryology in *Anona Cherimolia*. He finds a row of four megaspores and a considerable amount of parietal tissue. From the lowest megaspore is formed a narrow and much elongated embryo-sac, with apparently ephemeral antipodal cells. In the formation of endosperm a series of walls appears across the narrow embryo-sac, which becomes divided into a linear series of five or six large chambers, which subsequently become filled with tissue. The embryo has no suspensor, but arises from a globular mass of cells. The rumination of the seed is explained by the invasion of the perisperm by infoldings, chiefly of the inner integument. The author gives the name "reserve idioblasts" to masses of nutritive material found in abundance in cells along the convolutions of the rumination, and thought to supply nutrition to the embryo after the digestion of the endosperm.

Points in the Life-History of Apocynum.‡—T. C. Frye and E. B. Blodgett have studied the minute morphology of the flower and the

* Univ. Toronto Biol. Series No. 4 (1905) 64 pp., 5 pls. See also Bot. Gazette, xxxix. (1905) p. 429.

† Atti Acad. Gioenia Sci. Nat. Catania, xviii., Mem. 2 (1904) 26 pp., 1 pl. See also Bot. Gazette, xxxix. (1905) p. 430.

‡ Bot. Gazette, xl. (1905) pp. 49–53 (1 pl.).

gametophyte stage in *Apocynum androsæmifolium*. The chief points of interest are the origin of the tapetum from the homologue of the primary sporogenous layer instead of the primary tapetal layer, the gradation between bilateral and tetrahedral development of the pollen grains, the absence of a primary parietal cell in the ovule, and the single layer of cells composing the nucellus. There is also a general similarity to the internal structure of the flower in *Asclepias*.

Development of the Embryo-sac and Embryo of Batrachium longirostris.*—L. C. Riddle finds that the number of stamens in the flower of this species varies from 17 to 21, the number of carpels being approximately half as large; the mature ovule is enveloped by a single integument, traces of a second being seen in earlier stages. The microspore-mother-cell forms four microspores; no cases of more were found, as has been reported in *Ranunculus Ficaria* and other Ranunculaceæ. Scarcely one in four of the microspores germinates. Just before pollination the generative cell becomes lenticular, and divides to form the sperm nuclei. In the megasporangium the occurrence of two or more archesporial cells is frequent; the remains of other archesporial cells can almost always be seen around the megasporocyte. There is no evidence of the cutting off of any primary parietal cell, but the reduction division occurs at once. The lower of the two cells divides first, and in many cases the division of the upper seemed never to pass beyond the formation of the spindle. The functional megaspore passes through the usual divisions; the definitive nucleus was distinguished by its enormous size. Fertilisation was not observed. In the embryo the suspensor is short, and does not seem to function long after the formation of the endosperm. The cotyledons are small compared with the hypocotyl, and the embryo is straight. The entire embryo-sac is filled with endosperm cells of varying shapes and sizes, which contain abundance of starch. The inner wall of the carpel is made up of a layer of elongated cells, which are longest in the plane at right angles to the axis of the carpel. Next to these are a few layers elongated at right angles to the first and rather crescentic. As the ovule matures, these cells develop thick perforated walls, while the cells beneath the epidermal layer become somewhat separated to form a delicate spongy tissue.

The same author † has described the development of the embryo-sac and embryo of *Staphylea trifoliata*. The single archesporial cell develops a row of 3–5 tapetal cells, by which the spore-mother-cell is pushed deep into the tissue of the nucellus. The spore-mother-cell divides to form four megaspores, the lowest only of which is functional. The embryo-sac is typical, and the course of development of embryo and endosperm is quite normal.

Seed-Development in the Piperales.‡—D. S. Johnson has studied the development of the genera *Anemiopsis* and *Houttuynia* of the family Saururaceæ, and also representative genera of the Chloranthaceæ and

* Ohio Naturalist, v. (1905) pp. 353–63 (3 pls.).
† Tom. cit., pp. 320–5 (2 pls.).
‡ Johns Hopkins Univ. Circular, New Series, 1905, No. 5.

Lacistemaceæ. The result confirms the conclusion reached by Hofmeister, Strasburger, and Hegelmaier, that the structure and mode of development of the megaspore and gametophyte of the Angiosperms is not a satisfactory index of genetic relationship, since these features may vary very widely even within the limits of a single family or genus. Thus among the Piperaceæ, *Piper* has a typical embryo-sac with typically developed endosperm, and the closely related genus *Heckeria* is practically identical in these respects. *Peperomia*, as well known, shows a most remarkable deviation in the development of the embryo-sac. In all of these Piperaceæ only one megaspore is formed, and the tapetum is persistent even to the ripe seed. But in the Saururaceæ, the functional megaspore is one out of two potential megaspores in *Anemiopsis*, and one out of three in *Houttuynia* and *Saururus*. A tapetum is absent in *Houttuynia*, though formed and persistent in the other two genera. The embryo-sac is typically seven-nucleate, but the first division of the endosperm nucleus is followed by a cell-wall cutting the sac into an upper and a lower cell, only one of which, the upper, divides further to form a considerable mass of endosperm, the lower cell forming an elongated haustorium.

In *Lacistema*, a single archesporial cell gives rise to three potential megaspores, one of which forms a typical embryo-sac with endosperm formed at first by free-cell formation. *Hedyosmum* (Chloranthaceæ) differs in that the endosperm is cellular from the first. The author points out that we have here among a few genera a variety nearly as great as can be found in the whole group of Angiosperms. The facts noted supply no important evidence for or against the affinities of the Chloranthaceæ and Lacistemaceæ with the Piperales. But the complete replacement of the nucellar tissue by endosperm in *Hedyosmum* and *Lacistema*, and their well-developed embryo, show a marked contrast with the abundant perisperm, slight endosperm, and small embryo of the Piperaceæ and Saururaceæ.

Physiology.

Nutrition and Growth.

Development of Root-Hairs.*—L. M. Snow gives the results of her experiments on the causes of production of root-hairs. Light and darkness have apparently only an indirect effect through their influence on growth. High temperature with sufficient moisture tended to decrease hair production by increasing the elongation of the internal cells. The slower the rate of growth in air, the better is the development of the root-hairs. Retardation of growth by glass tubes, by wounding or by resistance of the substratum, favoured hair production. Saturated air at high temperature tended to suppress hair development, and a similar result obtained with saturated soil in corn and wheat. Less hair was developed in distilled than in tap water. Air deprived of oxygen stopped the development of hairs and also retarded growth. The activity

* Bot. Gazette, xl. (1905) pp. 12-48 (1 pl.).

of the epidermis may be in inverse proportion to the activity of the central cylinder, lateral roots often appearing when hairs are suppressed, and *vice versâ*.

Arrangement of Starch in the Starch-Sheath of the Perianth of Clivia.*—L. Gins, investigating the arrangement of the starch in the perianth-leaves of *Clivia nobilis*, finds only under the most favourable circumstances a tendency of the starch grains to lie on the physically lower cell-walls; in the great majority of cases no such tendency was shown. The perianth shows positive geotropism; and Němec had previously described the presence of a starch-sheath with well marked statolithic starch-grains.

Irritability.

Heliotropism Induced by Radium.†—Hans Molisch records a positive curvature in stems of seedlings when presented to rays from sealed tubes containing a mixture of radium bromide and zinc sulphide; he also confirms Dixon's result as to the failure of radium bromide alone to induce curvature. The author regards the curves as heliotropic, induced indirectly by radium. He also notes the interesting fact that the experiments usually fail in the greenhouse but succeed in the laboratory, and suggests as an explanation, that the impurities in the air of the laboratory tend to reduce negative geotropism and thereby increase the sensitiveness to phosphorescence and the heliotropic stimulus.

Influence of Light on Sporogonium-formation in Liverworts.‡—W. Kinzel indicates an interesting contrast between the action of light on the sexual and asexual generation. He finds that light is favourable to the formation of sporogonia, whereas it exercises an unfavourable influence on leaf-development.

Influence of Temperature on Respiration.§—M. K. Pourievitch has re-investigated the relation between temperature and the ratio of the two gases concerned in the process of respiration. He points out sources of error in the work of Bonnier and Mangin on the result of which it has been generally concluded that variation in temperature has no effect on the ratio $\frac{CO_2}{O_2}$, and shows from his own experiments that the ratio changes with the temperature, becoming greater as temperature rises. This effect is most noticeable in young organs, and depends on the nutritive substance present in the tissues, the influence of temperature becoming less as the nutritive substance disappears.

Traumatic Curvature in Roots.‖—G. P. Burns has repeated Spalding's experiment on traumatic curvature in roots. The previous

* Oesterr. Bot. Zeitschr., lv. (1905) pp. 92–6 (7 figs. in text).
† Ber. Deutsch. Bot. Ges. xxxiii. (1905) pp. 2–7 (fig. in text).
‡ Naturwiss. Zeitschr. Land. Forstw., iii. (1905) pp. 120–4. See also Bot. Centralbl., xcviii. (1905) p. 624.
§ Ann. Sci. Nat. Bot., ser. 9, i. (1905) pp. 1–32.
‖ Beiheft. Bot. Centralbl., xxviii. (1904) pp. 159–64 (4 figs. in text).

investigator found that roots damaged near the tip and prevented from curving by placing in plaster, show when removed from the plaster traumatic curvature precisely similar to that which would have taken place at first. He regarded this as indicating a latent period, which might be as long as eight days. The present writer, however, finds that the ultimate effect is due merely to continuation of the stimulus, which persists until the regeneration of the damaged portion is complete.

Effect of Leaf-fungi on the Productive Power of the Plant.*—As many cultivated plants suffer from spotting and partial destruction of their leaves from the attacks of various parasitic fungi, Aderhold has attempted to estimate by artificial methods the exact amount of damage done. He removed leaves from cereals and from beet plants, and found that in the case of barley the ears were 57–59 p.c. smaller in bulk when the leaves were all removed. Somewhat similar results were obtained in the case of the beet. The effect of fungicides on the leaves was also calculated; either no effect was produced, or the yield was perceptibly larger.

Resistance of Dried Plants to Poisonous Substances.†—Walther Kurzwelly experimented on various seeds and fruits, and on fungus spores, yeast cells, and bacteria. The fungi selected for experiment were *Aspergillus niger*, *Phycomyces nitens* and *Saccharomyces cerevisiæ*, and the poisons employed were alcohol, ether, benzol, carbon bisulphide, and chloroform. These were used in solution or as gases. The fungi were grown on sterile media and dried in sterilised paper two weeks or more. The principal results are summed up as follows:—Vegetative forms of the plant are less resistant to poisons than resting forms. For both forms it was found that fresh examples succumbed sooner than dried specimens, and that those dried in paper were more resistant than those dried in air, but in all cases the poison penetrated the tissues sooner or later. Spores digested in water were destroyed more quickly than dried spores; in this case much depended on the solubility in water of the poisons. The author found further that the addition of water to the poisons increased their action; and that as gases they acted still more quickly. By drying, the capacity to resist high temperatures was greatly increased. Details are given of the various experiments, and the time required to get results.

Chemical Changes.

Effects of Toxic Agents upon the Action of Bromelin.‡—J. S. Caldwell has made a series of experiments with a view to ascertaining whether a similarity existed between the effects of poisonous metals upon the action of an enzyme and those observed in experiments upon living organisms. Bromelin, the proteolytic enzyme in the juice of the pine-apple, was chosen as a typical vegetable trypsin. It was necessary

* Praktische Blätter Pflanzenb. und Pflanzensch., iii. (1905) Heft 2, pp. 14–17. See also Centralbl. Bakt., xiv. (1905) pp. 746–7.

† Jahrb. wiss. Bot., xxxviii. p. 291. See also Centralbl. Bakt., xiv. (1905) pp. 751–4.

‡ Bot. Gazette, xxxix. pp. 409–19.

to obtain the enzyme in as pure a state as possible, as impure preparations were found to be strongly auto-digestive in acid or alkaline media. The author found that the effects of poisons vary with the purity of the preparation used, slight amounts of proteid impurities rendering necessary an enormous increase of concentration in order to inhibit action. The toxic strengths of the salts used maintain a constant relationship irrespective of the purity of the enzyme used, that is, silver is always most poisonous, copper third, zinc sixth, and so on. Pure preparations of bromelin, which, moreover, are not auto-digestive, appear to be a mixture of two enzymes, one active in alkaline solutions, slightly more resistant to poisons, and twice as great in amount as the other, which is active in acid media, and is destroyed by heating to 65° C. in saline solution. The limits of toxicity and non-toxicity are somewhat more clearly defined than has been the case in experiments upon living organisms. The results obtained agree in general with Mathew's arrangement of the metals upon the theory that "the affinity of the atom or ion for its electrical charge is the main factor determining its physiological action."

General.

Botanical Relationship between Tropical Africa and America.*— A. Engler discusses somewhat fully the resemblances between the tropical African and American floras. The most important cases of identity or community of relationship between the seed-plants found on each side of the Atlantic are tabulated in twelve categories. In the majority of these it is possible to assume the transport of fruit or seed across the intervening ocean, but in several categories, which include forest, water, marsh, and steppe plants, such means of transport cannot have occurred. The author concludes that this community between the two floras is best explained by assuming the existence of a land connection between the district at the mouth of the Amazon and Biafra Bay in West Africa, either in the form of large islands or a continent. He also assumes a union between Madagascar and Natal; the continuation of this land mass in a north-easterly direction to Further India has long been considered probable. The suggested Brazilian-Æthiopian continent must have existed in the Jurassic period.

Flora of the Malayan Peninsula.†—A further instalment of King and Gamble's Malayan Flora contains the second half of the Rubiaceæ. It includes descriptions of 23 genera, comprising 123 species, 47 of which are new.

Blanco's Flora de Filipinas.‡—Elmer D. Merrill enumerates the species described by Blanco, and in many cases is able to identify these with species previously or subsequently described. Unfortunately none of Blanco's specimens are extant, and his descriptions are often

* SB. Preuss. Akad., vi. (1905) pp. 180-231.
† Journ. Asiat. Soc. Bengal, lxxiii. part 2 (1904) pp. 47-135.
‡ Dept. Interior Bureau Gov. Lab. Manila, No. 27 (1905) pp. 1-132.

inadequate. Blanco described 1127 species and varieties, 289 of which are to-day either unknown, or at least very imperfectly known only from his descriptions. Of 1623 species described by him as new, 297 have been referred to previously described species, and it is hoped that future work in the Philippines will enable us to identify a large percentage of those still unknown. His material came chiefly from the island of Luzon, and by far the greater part of this from provinces near Manila. Very few plants were from the higher altitudes.

Botany of the Southern Islands of New Zealand.*—L. Cockayne, under the title of "A Botanical Excursion during Midwinter to the Southern Islands of New Zealand," gives a somewhat full account of the geology, climate, and plant formations of the Auckland Islands, Campbell Island, the Antipodes Islands, and the Bounty Islands, and discusses the history of the flora of the Southern Islands generally. The flora includes 138 seed-plants, 54 of which (39 p.c.) are endemic, 26 (18·8 p.c.) Fuegian, 7 (5 p.c.) Fuegian which do not extend to New Zealand, and 58 (43·1 p.c.) New Zealand, excluding the New Zealand Fuegian element (19 species). The author favours the idea of a former land connection to account for the large South American element in the New Zealand flora. He also discusses the effect of animals, indigenous and introduced, upon the vegetation of these islands.

Fossil Grasses and Sedges.†—E. W. Berry recapitulates the evidence as to the existence of fossil Glumaceæ. There is no evidence of their existence in the Palæozoic floras, and very little definite evidence for the older Mesozoic. The Cretaceous seems to have been very poorly provided with sedges, judging from fossil remains, but grasses are quite numerous (*Arundo*, *Culmites*, *Poacites*, etc.). With the Tertiary both became more common, more than two score species of each type having been described from the Eocene; while from the Miocene numerous species founded on culms, glumes, inflorescences, leaves, and rhizomes, have been described. The author describes as *Carex Clarkii*, a new species which he finds to be abundant in the Atlantic coastal plain at a time when the transition beds between the typical Raritan and the typical Matawan were being laid down. The remains consist of fragments of leaves.

Japanese Mesozoic Plants.‡—M. Yokoyama gives an account of some fossil plants from Yamanoi and Bitchu. From the former he determines two species of *Cladophlebis* (one new), three of *Dictyophyllum* (two new), *Podozamites lanceolatus*, *Nilssonia Inouyei* sp. n., and *Baiera paucipartita*, and points out the indubitable Rhætic nature of the florula. From Bitchu he determines some fragmentary specimens of *Cladophlebis*, *Sagenopteris*, *Arthrophyopsis* (?), and *Nilssonia*, and also *Podozamites lanceolatus*. The specimens come from a plant-bed at Nariwa, im-

* Trans. New Zealand Inst., xxxvi. (1904) pp. 225–333 (14 pls.).
† Amer. Nat., xxxix. (1905) pp. 345–8 (fig. in text).
‡ Journ. Coll. Sci. Imp. Univ. Tokio, xx., Art. 5 (1905) pp. 1–13 (3 pls.).

mediately above the *Pseudomonites* bed, which is now generally accepted as an equivalent of the Noric stage of the Alpine Keuper.

X-Generation and 2X-Generation.*—J. P. Lotsy discusses the relation between the two generations, sporophyte and gametophyte, from the point of view of the number of chromosomes in the nucleus. The nuclei of the latter contain only half the number of chromosomes found in the nuclei of the former. Which generation should be called the x-generation? If the sporophyte, then the gametophyte becomes the $\frac{1}{2}x$-generation; if the gametophyte, then the sporophyte is the $2x$-generation. The author points out that the x-generation is the primitive generation, and that the $2x$-generation is later, its double number of chromosomes being due to fertilisation, and cannot exist indefinitely, sooner or later forming reproductive cells in which the primitive number of chromosomes is restored by separation of the paternal and maternal chromosomes. Numerical reduction of the chromosomes is the expression of the pairing of the kinds. In animals the body represents the $2x$-generation, and the sexual cells are the x-generation.

ARBER, E. A. N.—**On some New Species of Lagenostoma, a type of Pteridospermous Seed from the Coal Measures.**
[Describes two new species which show a close general agreement to the three species of the genus known previously. In one species, *L. Kidstoni*, the seeds are naked, in the other, *L. Sinclairi*, they were enclosed in a cupule recalling that of *L. Lomaxi*. In both cases the seeds were on the ends of the finer branches of a compound frond with reduced lamina, probably of the *Sphenopteris* type.
Proc. Roy. Soc., Series B. lxxvi. (1905) pp. 245–59 (2 pls.).

CORRENS, C.—**Gregor Mendel's Briefe an Carl Nägeli 1866–1873.** (G. Mendel's letters to C. Nägeli.) [Forming a supplement to Mendel's published work on hybridisation.] *Abhandl. Math. Phys. Kl. K. Sachs. Ges. Wiss.*, xxix. (1905) pp. 189-265.

HENRY, A.—**Forests, Wild and Cultivated.** (Lecture given before the Royal Dublin Society.) *Econom. Proc. R. Dublin Soc.*, i. (1904) pp. 231–47, pls. ix.-xx.

CRYPTOGAMS.

Pteridophyta.

(By A. GEPP, M.A., F.L.S.)

Chinese Ferns.†—H. Christ has examined the collections of Chinese ferns preserved in the Paris Museum, and gives a list of 254 species, 39 of which are described as new, as also are some score of varieties. He has studied the distribution of the species, the mingling of the Malayan and northern elements, the local peculiarities, the affinities of the species, and so forth. Several changes of nomenclature are made. *Neocheiropteris* replaces the generic name *Cheiropteris*, which is employed for an

* Biol. Centralbl. xxv. (1905), pp. 97–117.
† Bull. Soc. Bot. France, lii. (1905) pp. 1–69; Hedwigia, lxiii. (1905) Beibl. pp. 152–3.

extinct plant. Christ's paper is the most important monograph we have on Chinese ferns.

CHRIST, H.—**Filices Mexicanae.** (Mexican ferns.)
[List of the more interesting ferns collected by Munch in the S. Pablo district. Among them are described seven new species and two new varieties.]
Bull. Herb. Boissier, v. (1905) pp. 725–34.

" " **Quelques mots sur l'Article de Mr. Underwood: "A much-named Fern."** (Some words on Mr. Underwood's article.)
[A defence of certain changes of plant-names.]
Torreya, v. (1905) pp. 123–6.

CHRISTENSEN, C.—**Index Filicum sive enumeratio omnium generum specierumque Filicum et Hydropteridum.** (Index of Ferns or enumeration of all genera and species of Ferns and Hydropterideæ.)
[Gives the name, original reference and date, and synonymy of every species since 1753.] Copenhagen: Hagerup, 1905. Fasc. ii. pp. 65–128.

GILMAN, C.—**Two Ferns new to the Flora of Vermont.**
[Contains critical notes on *Nephrodium spinulosum* var. *fructuosum*.]
Rhodora, vii. (1905) pp. 103–5.

MAXON, W. R.—**A New Species of Fern of genus Polypodium from Jamaica.**
[*P. nesioticum*.] *Smithsonian Miscell. Coll., Washington*, xlvii. ii. (1905) pp. 410–11 (1 pl.)

OSTENFELD, C. H.—**A List of Plants collected in the Raheng District, Upper Siam, by Mr. E. Lindhard.**
[Contains four ferns and three Selaginellas, two of which are new, and are described in great detail by Hieronymus.]
Bull. Herb. Boissier, v. (1905) pp. 709–24.

PAUL, D.—**On the Ferns, especially the Filmy Ferns, of Jamaica.**
[Field Notes.] *Trans. Bot. Soc. Edinburgh*, xxii. (1901) pp. 1–12.

SODIRO, A.—**Sertula Floræ ecuadorensis.** (A selection from the Ecuador flora.)
[Descriptions of 13 new species of *Acrostichum*, of the section Elaphoglossum.]
Quito, 1905, 12 pp.; *Hedwigia*, xliv. (1905) Beibl. p. 154.

TUTCHER, W. J.—**Descriptions of some New Species, and Notes on other Chinese Plants.**
[Contains one new species, *Polypodium* (*Phymatodes*) *Matthewii*, and two new varieties of ferns.] *Journ. Linn. Soc.* (*Bot.*), xxxvii. (1905) pp. 58–70.

UNDERWOOD, L. M.—**A much-named Fern.**
[Gives the history of *Microstaphyla Moorei*—a Peruvian fern, which in the space of nine years has been described under three specific names and placed in four genera.] *Torreya*, v. (1905) pp. 87–9.

" " **Botrychium silaifolium Presl.**
[With this is now united *B. occidentale* Underw., and the species ranges from British Columbia to Washington State; and several Californian specimens are separated off as a new species, *B. Californicum*.]
Tom. cit., pp. 106–7.

Bryophyta.

(By A. Gepp.)

British Moss-flora.*—Dr. R. Braithwaite issues the final part of his illustrated monograph on the mosses of the British Isles. Begun in 1880, the work has been steadily carried out, and now forms the most elaborate memoir that has been published on the British Mosses. The classification and nomenclature are principally those which were established by S. O. Lindberg. The illustrations, synonymy, cited literature, distribution of the species, are very fully treated. The present part of the work contains the end of the Neckeraceæ—*Neckera*, *Alsia*, *Climacium*, *Fontinalis*, *Antitrichia*, *Leucodon*, *Cryphæa*, *Hedwigia*; and in a supplement are 24 species which have been added to our flora since the earlier text was printed. The general index completes the book, and shows that 622 species are recognised in the moss-flora.

Ceratolejeunea.†—A. W. Evans devotes one of his papers on the Hepaticæ of Puerto Rico to this genus. He traces out the history of the genus, shows that it is chiefly resident in the mountain forests of tropical America, refers to its creeping habit and deep pigmentation, and then describes in detail the structure of the leaves and lobules and the special characters of the four-horned perianth. One new species is established, and four others are carefully re-described and annotated.

Andrews, A. L.—**Additions to the Bryophytic Flora of West Virginia.**
[A list of 33 mosses and 15 hepatics.] *Bryologist*, viii. (1905) pp. 63–5.

Bottini, A.—**Frammenti di Briologia italiana.** (Fragments of Italian bryology.)
[Lists of 38 mosses of the Abruzzo and 63 mosses of the Campagna, several being new to those districts.]
Webbia, edited by U. Martelli (Firenze, 1905) pp. 17–24.

Britton, E. G.—**A long-lost Genus to the United States—Erpodium (Brid.) C.M.**
[*E. biseriatum*, originally described as a hepatic, *Lejeunia biseriata*, by Austin in 1869, and transferred by him to the mosses in 1877, has remained in oblivion ever since. The type, which was collected near Augusta, Georgia, in 1845 by Sullivant, has lately been found in Columbia University Herbarium.] *Bryologist*, viii. (1905) p. 71.

Cardot, J., & I. Thériot.—**New or Unrecorded Mosses of North America.**
[Descriptions of five new species and varieties.] *Tom. cit.*, pp. 71–3.

Casares-Gil, A.—**Nota briologica.** (Bryological note.)
[Catalogue of 16 hepatics and 22 mosses which appear new for the flora of Spain.] *Bol. Real Soc. Españ. Hist. Nat.* v. (1905) pp. 175–9; *Rev. Bryol.*, xxxii. (1905) p. 84.

Cocks, Ll. J.—**Supplementary Report on Mosses.**
[List of 91 of the rarer mosses collected during an excursion of four days on the Breadalbane mountains at the end of July 1900.]
Trans. Bot. Soc. Edinburgh, xxii. (1901) pp. 41–5.

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* British Moss-flora, xxiii. (May 1905) pp. 201–74, pl. cxxi.–cxxviii. London, published by the author.

† Bull. Torrey Bot. Club, xxxii. (1905) pp. 273–90 (2 pls.).

CUFINO, L.—**Osservazioni ed aggiunte alla Flora del Canada.** (Observations on and additions to the Flora of Canada.)
[Contains 31 mosses of British Columbia.]
Malpighia, xix. (1905) pp. 187–196.

CULMANN, P.—**Contributions à la flore bryologique du Canton de Bern.** (Contributions to the moss-flora of Canton Bern.)
[Contains lists of hepatics and mosses, with detailed notes on *Diplophyllum exsectæformis* var. *æquiloba*, *Schistidium teretinerve* and *Myurella julacea* var. *scabrifolia*.] *Rev. Bryolog.*, xxxii. (1905) pp. 73–9, fig.

DIXON, H. N.—**Notes on a Bryological Tour in the Pyrenees.**
[Contains lists of mosses gathered at Bagnères-de-Luchon, Gavarnie and Cauterets in the summer of 1902.] *Tom. cit.*, pp. 61–73.

EVANS, A. W.—**A remarkable Ptilidium from Japan.** (To this genus is transferred the hepatic *Mastigophora Bisseti* Mitt., because of its blunt branches and multifid leaves with marginal cilia; it is remarkable also for having water-sacs on some of its smaller leaves and numerous multicellular hairs on the outer surface of both leaves and underleaves—a rare character in Hepaticæ. A new and full description of the plant is given.)
Tom. cit., pp. 57–60, fig.

" " **Diagnostic Characters in the Jungermanniaceæ.**
[A simple account of the main differences observable in the arrangement and shape of the leaves, inflorescence, perianth, etc., in the North American hepatics.]
Bryologist, viii. (1905) pp. 57–63 (1 pl.).

FEDTSCHENKO, O. & B.—**Matériaux pour la Flore de la Crimée.** (Materials for the Crimean flora.)
[Contains a list of 14 mosses and 2 hepatics determined by V. F. Brotherus.]
Bull. Herb. Boissier, v. (1905) pp. 621–38.

HERZOG, TH.—**Die Laubmoose Badens. Eine bryogeographische Skizze.** (The Mosses of Baden. A bryogeographic sketch.)
[Continuation.] *Tom. cit.*, pp. 573–88; 768–83.

HY, F.—**Note sur une Grimmia.** (Note on a Grimmia).
[Critical remarks on *G. edentula*, a new species found at Angers. It is a small gymnostomous plant.] *Rev. Bryolog.*, xxxii. (1905) pp. 82–3.

JAAP, O.—**Weitere Beiträge zur Moosflora der Nord-friesischen Inseln.** (Further contributions to the moss-flora of the North Friesian Islands.)
[The islands of Sylt, Amrum and Föhr yielded 130 mosses, 16 sphagna, 44 hepatics. The rare *Haplomitrium Hookeri* was found in Röm.]
Schrift. Nat. Verein. Schleswig-Holstein, xiii. (1905) pp. 65–74.

JACKSON, A. B.—**Leicestershire Mosses.**
[A list of 161 species and varieties, containing over 50 additions to the moss-flora of the county as published in 1886.]
Journ. Bot., xliii. (1905) pp. 225–31.

MARTIN, A.—**Note bryologique sur Saint-Gervais-les-Bains et sur la vallée de l'Arve (Haute-Savoie).** (Bryological note on St. Gervais-les-Bains and the Arve Valley, Upper Savoy.)
[A list of 39 mosses and 12 hepatics.] *Rev. Bryol.*, xxxii. (1905) pp. 79–82.

MÜLLER, K.—**Lebermoose aus den Pyrenäen gesammelt im Sommer 1903.** (Hepatics gathered on the Pyrenees in the summer of 1903.)
[The author wandered along the whole range and collected 87 species, 10 of which are new to the Pyrenean flora. Numerous localities are given.]
Bull. Herb. Boissier, v. (1905) pp. 589–602.

NEUWEILER, E.—**Die prähistorischen Pflanzenreste Mitteleuropas mit besonderer Berücksichtigung der schweizischen Funde.** (The prehistoric plant-remains of Middle Europe, with special consideration of those discovered in Switzerland.)
[Contains lists of mosses amounting to nearly 30 species in all.]
Vierteljahr. Naturf. Ges. Zürich, v. (1905) pp. 23–134.

NICHOLSON, W. E.—**Tortula pagorum (Milde) De Not.**
[On the habitat and limited distribution of this species in South Europe and its recorded occurrence in Georgia (U.S.A.). It is probably a xerophytic form of *T. lævipila*, with which it is connected through *T. lævipilæformis*.]
Bryologist, viii. (1905) p. 70.

PARIS, E. G.—**Index Bryologicus.**
Paris: Hermann, 1905, 2nd ed. iii. fasc. 3–4, pp. 137–264.

RENAULD, F., & J. CARDOT.—**Mousses.** (Mosses.)
Grandidier's Hist. Phys. Madagascar, xxxix. (Paris, 1905), Atlas, v. tt. 144–63 [no text yet issued].

STEPHANI, F.—**Species Hepaticarum.** (Species of Hepatics.)
[Continuation, giving descriptions of 32 American species of *Plagiochila*, 13 of which are new.] *Bull. Herb. Boissier*, v. (1905) pp. 736–51.

Thallophyta.

Algæ.

(By MRS. E. S. GEPP.)

Marine Algology.*—A. Mazza publishes the first instalment of his notes on marine algæ, intended by him to assist and encourage the amateur collector. He does not aim at superseding the well-known handbooks, and rightly refers to De Toni's Sylloge Algarum as indispensable to all systematists and collectors, but for the benefit of the uninitiated he embodies his own observations in the form of notes on each of the more common species. He begins with Bangiaceæ and deals with four genera including 12 species. The beginning only of *Chantransia* is given in this part. After the remarks on each species, references are given to specimens of which the geographical distribution is mentioned. The usefulness of such a work as this is self-evident.

South Orkney Marine Algæ.†—Two short papers on algæ from these islands appear together, one by A. and E. S. Gepp, and the other by E. M. Holmes. The former is an account of some material sent to the authors after the publication of their previous paper. It includes one new species, *Hydrolapathum stephanocarpum*, closely allied to *H. sanguineum*; and describes and figures two other algæ which are sterile and doubtful. The *Leptosarca simplex* of their former paper is transferred to *Gracilaria* on the strength of the tetraspores which are found in the material of this last consignment. The paper by E. M. Holmes includes records of four calcareous algæ, two of which have been described as new forms by M. Foslie in a previous publication. Fragments of six species on non-calcareous algæ were found adhering to the corallines, and are included in this paper.

* Nuov. Notar., xvi. (1905) pp. 85–101.
† Journ. Bot., xliii. (1905) pp. 193–8.

Seaweed Industries.*—H. M. Smith embodies in an interesting and instructive paper an account of the methods of taking and utilising seaweeds in Japan. Many different species are used for various purposes, but the principal preparations are made from *Gelidium corneum*, *Gloiopeltis coliformis*, species of Laminariaceæ, and *Porphyra laciniata*. The manner of preparation is described and figured, as well as the uses to which the product is put when completed. The value of seaweeds prepared in Japan at the present time exceeds two million dollars annually. Many species are used for human food and also for fertilisation of the soil. The same author publishes together with this a second paper on the utilisation of seaweeds in the United States. In that country the seaweed industry is very small and practically restricted to Massachusetts, where *Chondrus crispus* is collected, prepared and sold to brewers, druggists, and grocers in the United States and Canada. The author points out that the seaweed industry could be made very profitable in America.

Dictyosphæria.†—A. Weber van Bosse describes two new species of this genus, *D. Versluysii* and *D. intermedia*. The former has often been erroneously confounded with *D. favulosa*, though C. Agardh had rightly described that species as being hollow even in its youngest stages. This character, the hollowness or solidity of the respective species, is indeed the determining one, *D. favulosa* being always hollow, while *D. Versluysii* is solid; *D. intermedia* on the other hand represents a species which in certain characters resembles both the above-mentioned species. The author regards the genus as being composed of four species only, the fourth being *D. sericea*. Diagnoses are given of the two new species and of *D. favulosa*. All of these occur in the collections of the 'Siboga' from the Malay Archipelago.

Diatoms of the Territories.‡—A. M. Edwards reports on 16 samples of fossil Diatoms collected by Dr. Hayden, of the U.S. Geological Survey of the Territories. Some of these samples were specially interesting, since they came from what the author calls the Occidental Sea. Two new species are mentioned but not described: *Cyclotella gigantea*, which looks like a much overgrown *C. Kuetzingiana*, and *Stephanodiscus major*, which may be an exaggerated form of *S. Niagaræ*.

Cytology of the Forms of Stigeoclonium.§—N. Yatsu has studied the differences between the palmella form and the filamentous form of *Stigeoclonium*. The latter form has a central vacuole and has a thinner wall, smaller chlorophyll granules, and smaller pyrenoids than are found in the palmella stage. The plant changes from the one form to the other when transferred to a suitable culture solution. The palmella form occurs in dry atmospheres, and perhaps is enabled by its thicker wall and larger pyrenoid to withstand desiccation. The palmella form, when cultivated in a weak solution, usually produces two, four or eight

* Bull. Bureau Fisheries, Washington, xxiv. (1904) pp. 133–81 (5 pls., figs. in text).
† Nuov. Notar, xvi. (1905) pp. 142–4.
‡ Tom. cit., pp. 81–4. § Torreya, v. (1905) pp. 100–4 (fig.).

zoospores. The best fixing solution was found to be Boveri's picro-acetic acid. The methods of fixing, section-cutting, etc., are described.

CUSHMAN, J. A.—**A Contribution to the Desmid Flora of New Hampshire.**
[An annotated list of 60 North American species, with many varieties and forms. *Closterium intervalicola* and *Pleurotænium sub-georgicum* are new species.] *Rhodora*, vii. (1905) pp. 111–19 (1 pl.).

KUCKUCK, P.—**Der Strandwanderer.** (The wanderer by the shore.)
[A more or less popular account of the marine algæ and animals found at the seaside. The book is illustrated in colours and is intended for amateurs.] Munich: J. F. Lehmann, 1905, 76 pp. 24 pls

MIGULA, W.—**Kryptogamen-Flora.** (Cryptogamic Flora.)
[Algæ, continued.]
Thomé's Flora von Deutschland (Gera: F. v. Zezschwitz, 1905) v. Lfg. 22, pp. 113–44 (5 pls.)

PENARD, E.—**Encore la Chlamydomyxa.** (More about Chlamydomyxa.)
[Reply to criticisms.] *Bull. Herb. Boissier*, v. (1905) pp. 517–26.

RICHARDS, H. M.—**Some Edible Seaweeds.**
[Abstract of an account of some 15 species employed chiefly by the Japanese and Chinese.] *Torreya*, v. (1905) pp. 94–6.

SUHR, J.—**Die Algen des östlichen Weserberglandes.** (The algæ of the eastern mountain district of the Weser.)
[A continuation of this paper, containing an enumeration of 342 species of diatoms with their habitats in the district.]
Hedwigia, xliv. (1905) pp. 241–88.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Vegetable Pathology.* — Vittorio Peglion has had his attention called to the decay of a field of lucerne in the valley of the Po. Examination showed the presence of small tubercles chiefly on the stalk at the base of the lowest leaves. These were caused by a species of Chytridiaceæ, *Urophlyctis alfalfæ*, described by Magnus on lucerne plants from Alsace. The tubercles were found to be full of the brown spores of the fungus. Peglion did not follow the development of the fungus.

Delacroixia coronata.† — I. Gallaud has taken advantage of the saprophytic habit of this genus of Entomophthoreæ to make a series of artificial cultures. He has thus been able to follow its life-history in detail. In a hanging drop culture he found that the spores germinated freely and soon produced other spores at the end of a short filament. When the culture was comparatively old a number of smaller spores were formed, some of them being echinulate. All the spores had a clear papilla. In certain conditions of humidity the spores formed spicules, and these occasionally grew out and produced small spores at their extremities. No oospores were found, and their absence, together with the rapid drying up of the ordinary spores, probably accounts for the rarity of *Delacroixia*.

* Atti Reale Accad. Lincei, cccii. (1905) pp. 727–30 (1 fig.).
† Ann. Sci. Nat. Bot., i. ser. 9 (1905) pp. 101–33 (4 figs.).

Infection experiments on living insects were unsuccessful, but a vigorous growth was obtained on a dead cockroach. Various cytological observations were made by the author. He demonstrated the presence of metachromatic corpuscles, and the presence of numerous nuclei in the spores, etc. He considers the fungus to be near *Basidiobolus* and *Conidiobolus*, but generically distinct from both.

Mucor Species and Alcohol.*—C. Wehmer has been considering the problem of the behaviour of species of *Mucor* and other fungi of the *Aspergillus* and *Penicillium* genera in regard to alcohol produced by themselves in fermentation, or when it was introduced into the cultures. He found with *Mucor racemosus* and *M. javanicus* that the alcohol content of the culture became gradually less. He is, however, of opinion that evaporation accounts largely for the disappearance of the alcohol, and that the breaking up of the alcohol by the fungus is very slight.

Rhizopus oligosporus.†—K. Saito adds from China another to the large number of economic fungi that have been recorded in Eastern lands. It was found on a cake of rice meal, and was so named owing to the sparing formation of spores. The sporangia, at first colourless, became black and wasted; the spores are greyish-brown. The fungus grows vigorously, and converts starch into sugar with formation of alcohol.

A New Species of Wynnea.‡—Roland Thaxter has found a third species of this genus in North Carolina. It grew, like the other species, from a sclerotium buried in the soil. The ascophores are borne in clusters that branch from a common stalk. They are elongate, ear-shaped, and very variable in size. Thaxter gives an historical account of the three species constituting the genus, collected respectively in India, Mexico and North Carolina. The new species is characterised by its rich dark-brown colour, and by the large spores.

Observations on Pezisa ammophila.§—G. Muscatello has been examining this fungus which grows on the maritime dunes of Catania in Sicily. He does not think it lives in symbiosis with the roots of the grasses. The stalk owes its peculiar formation to the necessity of conducting and accumulating water. The asci originate from the fusion of two equal gametes. The metachromatic granules aid in spore formation and in the development of the exospore.

Sclerotiniæ of Fruit Trees.‖—R. Aderhold and W. Ruhland have cultivated several forms of *Sclerotinia* on apples, apricots, and cherries, and they have determined three distinct species which are marked by slight but constant differences in the size of asci and spores, and in the

* Ber. Deutsch. Bot. Ges., xxiii. (1905) pp. 216–17.

† Centralbl. Bakt., xiv. (1905) pp. 623–7 (1 pl.).

‡ Bot. Gazette, xxxix. (1905) pp. 241–7 (2 pls.).

§ Atti Accad. Gioenia Sci. Nat. Catania, Feb. 1905, pp. 1–15 (1 pl.). See also Bot. Centralbl., xcix. (1905) pp. 66–7.

‖ Arb. biol. Abt. Land. und Forstw. Kais. Ges., iv. 5 (1905) pp. 427–42. See also Hedwigia, xliv. (1905) pp. 144–5.

size of the conidial form. The three species dealt with are *Scl. fructigena* on apples; *Scl. laxa* on apricots; and *Scl. cinerea* on cherries.

Sclerotium Disease of the Alder.* — Ed. Fischer has made new observations on the *Sclerotinia* found in the fruits of the Alder as developed in *Alnus viridis*. He finds that the whole interior of the fruit is occupied by the fungus. The outer layers of the sclerotium are brownish-violet, and are covered with a layer of colourless hyphæ, which bear at the tips chains of very small conidia. It was not determined if they were capable of germination. Fischer considers that the fungus on *A. viridis* is identical with those that are found on *A. incana* and *A. glutinosa*. The apothecial fruits have not been found in any of these.

Disease of Olive Trees.†—G. Cuboni has investigated a disease of olive trees termed "Brusca," which has worked much mischief in certain districts. On the leaves of the diseased trees Cuboni has found constantly the fungus *Stictis Panizzi*. The leaves so attacked drop from the trees, leaving them bare. He does not, however, think that the evil is caused by the fungus, but that it is due rather to climatic and soil conditions.

L. Petri,‡ who is of opinion that the disease is due to the fungus, has been making successful cultures with the spores. He has produced a pycnidial form resembling a *Cytospora*, and also the ascomycetous fruits on agar prepared with a decoction of olive leaves.

Erysiphaceæ of Japan, II.§—E. S. Salmon published in 1900 an account of Japanese Erysiphes; in the present paper he brings the work up to date, and adds a considerable number of species to those already recorded. He notes the occurrence there of species only found previously in America. Salmon finds that *Ampelomyces quinqualis* Ces. (*Cicinnobolus Cesatii*), a fungal parasite of the Erysiphaceæ, is common in Japan, sometimes preventing the formation of conidia or perithecia. Host index and bibliography are added.

Infection Experiments with Thielavia basicola.‖ — R. Aderhold finds that this fungus grows readily on pieces of sterilised pear, carrot, etc. Only the conidial forms were produced: neither pycnidia nor perithecia were formed. The development of conidia and chlamydospores was followed and carefully described.

On the Occurrence of Saccharomyces anomalus in the Brewing of Saké.¶—K. Saite isolated a mould yeast from fresh saké and studied it carefully, but he was not able to state if it was identical with those already determined as taking part in the formation of saké. He describes the form of growth in artificial cultures, and the form of the

* Centralbl. Bakt., xiv. (1905), pp. 618–23 (1 pl.).
† Atti Reale Accad. Lincei, cccii. (1905) pp. 693–5.
‡ Tom. cit., pp. 687–8. § Ann. Mycol., iii. (1905) pp. 239–56.
‖ Arb. biol. Abt. Land. und Forstw. Kais. Ges., iv., 5 (1905) pp. 463–5. See also Hedwigia, xliv. (1905) p. 145.
¶ Journ. Coll. Sci. Imp. Univ. Tokyo, xix. Art. 18 (1904) 14 pp. See also Ann. Mycol., iii. (1905) pp. 214–15.

yeast and of the ascospores. The latter are cap-shaped, and are 2–4 in a cell. He considers the yeast to be closely related to *Saccharomyces anomalus*.

The Yeasts of Charente.*—Andre Descoffre divides his work on yeast into six chapters, which treat of (1) the origin of yeasts and their dissemination; (2) the technical microbiology adopted for the selection of species and races; (3) anatomical and physiological researches; (4) the action of exterior agents of different kinds on these micro-organisms; (5) the fermentation of the "must" of *Charente*; (6) résumé and conclusion. He takes note of the discoveries already made as to the hibernation of yeasts in the soil; some live on the surface, others pullulate at a depth of 10 cm. Insects play a considerable part in dissemination, but the wind is the chief agent. The quality of the yeast is strongly affected by the soil, the special *Charente* growth being limited to the chalk soils. Definite odours and flavours are given to the product of fermentation according to the species of yeast employed. The author gives instructions how to secure the desired results. He also describes methods of examining, staining, etc., the yeast cells. Spores are formed in three days in *Saccharomyces ellipsoideus campaniensis* when the fungus is grown on porcelain.

Development of Yeast in the Soil.†—Emil. Chr. Hansen published a paper on this subject some time ago. He found then that, in nature, yeasts grew largely on decaying fruit and, in moist situations, on plant remains, etc. But he found then, and has again proved, that the soil is the great breeding ground not only in winter but during the whole year. His researches included *Saccharomyces* and species of *Torula* and *Mucor*. He remarks on the great power of resistance to drought possessed by *Mucor*.

Research on Fungi imperfecti.‡—H. Klebahn has attacked the problem of the pycnidial form of the Pyrenomycetes, and in two cases he has established the connection between the different life-stages of growth. The first he experimented with was *Phleospora Ulmi*, a parasite of the leaves of different species of elms. It forms a hymenial layer of hyphæ under the lower surface of the leaf, and from the hymenium are given off colourless, 3-septate spores. *Phleospora* has been reckoned among the Sphæroideæ, but there is no perithecial chamber formed, and the habit of growth accords more nearly with the Melanconieæ. Klebahn successfully infected young leaves with the spores from *Phleospora*, and reproduced the pycnidial form. By keeping infected leaves in suitable conditions during the winter, he got the ascosporous stage, *Mycosphærella Ulmi*, a small perithecium imbedded in the decaying tissue of the leaf. The ascospores were sown on the young leaves, and they gave rise to *Phleospora Ulmi*.

* Bordeaux (1904) i., 8vo, 128 pp. See also Bot. Centralbl., xcviii. (1905) pp. 651–2.
† Centralbl. Bakt., xiv. (1905) pp. 545–50.
‡ Jahrb. Wiss. Bot., xli. (1905) pp. 485–560 (75 figs.).

Artificial cultures were also carried on, the methods being described in detail. The conidia of *Phleospora* and the ascospores of *Mycosphærella* germinated alike, and produced similar conidia. Aggregates of hyphæ were formed in the cultures, evidently the beginnings of perithecia, but the complete fruit was not produced.

The second fungus experimented with, *Gnomonia Veneti*, grows on Plane leaves. Klebahn gives a long account of the systematic position of the fungus, and also of *Glœosporium*, *Myxosporium*, *Discula*, and *Fusicoccum*, species of which grow on the same leaves. By examination and experiment he has proved that all of these are stages of *Gnomonia Veneti*. He has also produced in artificial cultures a mould-form belonging to the Hyphomycetes. The systematic difficulty of stages of the same fungus belonging to such widely differentiated groups is discussed by the author. The *Glœosporium* and *Myxosporium* stages of the fungus are produced on the leaves and twigs while still on the tree. The later forms, *Fusicoccum* and *Gnomonia*, grow on the dead leaves on the ground. The more advanced stages are thus saprophytic. As a parasite, the fungus does not do any serious harm to the tree.

Disease caused by Penicillium glaucum.*—Vittorio Peglion noted from time to time that the familiar blue mould was always present on decaying chestnuts, and not only on old chestnuts but on those recently gathered. He cultivated the *Penicillium*, and applied to it a test for determining poisonous qualities in filamentous fungi. He brought it up to boiling point in a 2 p.c. solution of potash, then added sulphuric acid. The acid mixture was then shaken up with benzine, and afterwards ferric chloride was added. Almost immediately a thin stratum in the liquid took on a bright green colour, proving the presence of "phenol," the poisonous substance of Hyphomycetes. Peglion does not consider that all the forms of *Penicillium* have the same poisonous qualities. He thinks that probably chestnut meal containing the fungus in question is the origin of the skin disease called "pellagra"—cases of which disease occur among people who make use of chestnut meal as an article of diet.

Phellomyces sclerotiophorus.†—Frank gave this name to a sterile fungus causing a disease of potatoes, usually confined to the skin, but not infrequently penetrating the tissue of the tuber. O. Appel and R. Laubert have succeeded recently in inducing further development of the black stromata formed by the fungus. Upright brown conidiophores bearing at intervals verticils of brown septate conidia were produced, and these corresponded to *Spondylocladium atrovirens* found by Harz on potatoes and described by him. The name *Phellomyces* must, therefore, be dropped in favour of the previous designation.

Hyphomycetes.‡—The Botrydideæ which G. Lindau commenced in the previous fascicle is completed in the present issue. He divides the genus *Botrytis* into four sub-genera: *Eubotrytis*, *Polyactis*, *Phymato-*

* Atti Reale Accad. Lincei, cccii. (1905) pp. 45–8.
† Ber. Deutsch. Bot. Ges., xxiii. (1905) pp. 218–20.
‡ Rabenhorst's Kryptogamen Flora, Band i. Abt. 8, Lief. 96 (Leipzig, 1905) pp. 257–320.

trichum, and *Cristularia*. The Verticilliеæ follow next in order. The genus *Pachybasium*, with three species, is described, and several of the species of *Verticillium*. The genera are illustrated in the text.* In the succeeding part the Verticilliеæ are concluded, and the Gonatobotrytideæ. The group Hyalodidymeæ, with colourless 2-celled spores, is commenced. It is satisfactory to note that Lindau sinks *Cephalothecium*, a genus similar to *Trichothecium*.

Cercospora beticola parasitic on Sugar and Fodder Beet.†—J. Uzel describes this disease, which makes itself known by grey or brown spots on the leaves. Infection takes place through the stomata; the mycelium burrows in the intercellular spaces, finally penetrating the cells. The conidiophores pass out again through other stomata. The conidia are terminal: after the first one falls, a second is produced a little lower on the stalk, which in turn becomes terminal. The conidia winter in the soil on the decaying leaves.

North American Uredineæ.‡—E. W. D. Holway has issued Part I. of a projected comprehensive account of Uredineæ. He gives a short account of *Puccinia*, and then gives detailed diagnoses of the different species, grouping them under the various natural orders, genera, and species of host plants. Those described all grow on the western continent. The spores are illustrated by photomicrographs.

Mexican Rusts.§—J. C. Arthur publishes a list of Rusts on Leguminosæ, many of them new, from material collected in Mexico by E. W. D. Holway. The genera *Ravenelia* and *Uropyxis* are specially well represented. He describes a new genus *Calliospora* with three species. The teleutospores alone have been seen. They have two lateral germ pores in each of the two cells of the spore.

Genus Cortinarius.‖—Calvin H. Kauffman publishes a preliminary study of this the largest genus of the Agaricaceæ. He follows the example of Fries in the subdivisions, but he thinks that these subgenera proposed by Fries are distinct enough to be reckoned as genera. All the *Cortinarii* are distinguished by the brown spores and the cobweb-like veil or cortina. Many of them are brightly coloured, but as they tend to fade quickly that is not a good diagnostic character. The shape of the spores he considers to be more useful in determining species. Kauffman gives an account of the general habitat of these plants, and advises the beginner as to the points to be examined and noted. A key of the American species is given, and diagnoses of several new species.

Mycological Notes.¶—C. G. Lloyd has just issued No. 19 of his notes, dealing principally with the genus *Lycoperdon*. He publishes

* Rabenhorst's Kryptogamen Flora, Band i. Abt. 8, Lief. 97 (Leipzig, 1905) pp. 321–84.
† Prague (1904) 16 pp., 2 pls. See also Bot. Centralbl., xcviii. (1905) pp. 602–3.
‡ North American Uredineæ, i. Part 1 (Minneapolis, 1905) 32 pp. (10 pls.).
§ Bot. Gazette, xxxix. (1905) pp. 385–96.
‖ Bull. Torrey Bot. Club., xxxii. (1905) pp. 301–25.
¶ Cincinnati, May 1905, pp. 205–20 (14 pls.).

photographic plates of the species, with descriptions of the European specimens. These he divides into five sections: *atropurpureum*, *geminatum*, *pratense*, *polymorphum*, and *spadiceum*. He finds that *Lycoperdon perlatum* is identical with *geminatum*. Notes are added on several other genera and species. Lloyd publishes again a request that puff-balls should be sent to him by collectors.

Experiments with Parasitic Fungi.†—W. Loewenthal has been testing the effect of *Plasmodiophora Brassicæ* and *Synchytrium Taraxaci* on animal tissues. Both of these organisms cause great distortion on the host-plants which they attack. Loewenthal's experiments gave negative results. The organisms are highly specialised parasites, and do not attack plants indiscriminately, much less animals. He describes in detail the development of both fungi.

Handbook of Plant Diseases.‡—P. Sorauer is bringing out a new edition of his handbook with the assistance of G. Lindau, who undertakes the parasitic fungi, and L. Reh, who is to be responsible for the part dealing with insect pests. Sorauer himself describes the diseases due to inorganic influences such as soil, climate, smoke, etc. Two parts have already been issued, the first dealing with disease, predisposition, and cure. A history of plant diseases follows, and an account of the harm wrought by unfavourable soil conditions. The second part treats of parasitic fungi, beginning with myxomycetes, bacteria, and filamentous fungi.

Fungoid Diseases of the Cotton Plant.§—Notes are published on the occurrence of a root disease of cotton in German East Africa, caused by a fungus *Macosmospora vasinfecta* and to be recognised by the dwarfing of the plants and the yellowing of the leaves. The roots are attacked when young, the mycelium penetrating the tissues and then spreading all round the infected spots. Digging a trench round the area of diseased plants is advised. A secondary harmless parasite *Diplodia Gossypii* was also found on the roots, along with *Phyllosticta gossypina*. *Alternaria macrospora* has been observed on the dead leaves: it is uncertain what damage it causes.

American Mycology.‖—A. P. Morgan writes a note on the genus *Gibellula*, and describes a new species, found growing on small dead insects. J. C. Arthur ¶ publishes the fifth of a series of reports on the culture of plant rusts. Many of the cultures were undertaken to verify work previously done, and were successful. In five cases æcidial and teleutosporic connections were established. Full details of these and of the cultures are given; the rusts were all heterœcious, and are reported for the first time. W. A. Kellerman and P. L. Ricker* continue their list of new genera of fungi published since 1900.

* Zeitschr. Krebsf., iii. (1905) 16 pp., 1 pl. See also Ann. Mycol., iii. (1905) p. 212.
† P. Parey (Berlin, 1905) i. Lief 1, and ii. Lief 2.
‡ Bull. Imp. Inst., iii. (1905) pp. 60–2.
§ Journ. Mycol., xi. (1905) pp. 49–50.
‖ Tom. cit., pp. 50–67.
¶ Tom. cit., pp. 68–96.

Disease of Sugar Beet.†—M. Hollrung includes *Phoma Betæ* in his account of the organisms that work harm to the sugar beet. He finds that when the soil is too dry the plant is insufficiently nourished, and more easily succumbs to the attack of the parasite. He finds, too, that if the plant has a very luxurious growth at the beginning, it is less able to withstand subsequent drought; he therefore recommends spare manuring at an early stage, in order to restrict an over-abundant development.

Technical Mycology.‡—F. Lafar has just issued the fifth part of his handbook. W. Benecke has prepared the chapters that deal with the physiology and elements of nutrition, and the action of minute organisms in the breaking up of substances. J. Behrens takes up the question of external influences on fermentation. In other chapters are discussed symbiosis, metabiosis, and antagonism, and incidentally full directions are given for the culture of fungi. The presence of enzymes and the agents that favour or hinder their formation are also discussed in this number.

Fat Bodies in Plant Nuclei.§—These bodies have been detected by Carnoy in the nuclei of certain animal cells. Zopf and Nowakowski had suspected their presence in the nuclei of the zoospores of Chytridiaceæ. R. Maire has recently demonstrated their existence in the nuclei of young protobasidia of *Coleosporium Campanulæ*. The formation of the minute fat particles begins in the secondary nuclei; at a more advanced stage they disappear from the nuclei, and are to be found only in the protoplasm. Their presence has also been proved in the nuclei of the spores of *Elaphomyces variegatus*. Maire considers that such bodies are to be found in all nuclei.

ADERHOLD, R.—**Einige neue Pilze.** (Some new Fungi.)
[Several species of microfungi, parasitic on leaves, etc., are described.]
Arb. biol. Abt. Land-Forstw. Kais. Ges., iv. 5 (1905) pp. 461–3 (4 figs.).
See also *Hedwigia*, xliv. (1905) p. 145.

" " **Zur biologie und Bekampfung des Mutterkornes.** (Biology and Destruction of Ergot.)
[It is recommended to burn the diseased grasses; burying is not always successful, and a small piece of dry sclerotium can form the ascus fruit.]
Op. cit., v. 1 (1905) pp. 31–6.
See also *Hedwigia*, xliv. (1905) p. 145.

BUBAK, FR.—**Beitrag zur Kenntniss einiger Uredineen.** (Contributions to the knowledge of some Uredineæ.)
[Notes on species already described and descriptions of new forms from Bohemia, Montenegro, etc.] *Ann. Mycol.*, iii. (1905) pp. 217–24.

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* Zeitschr. Ver. Deutsch. Zuckerind. 1905, p. 407. See also Centralbl. Bakt., xiv. (1905) pp. 750–1.

† Handbuch der technischen Mykologie (Jena, 1905) Heft 5. See also Bot. Centralbl., xcix. (1905) pp. 29–30.

‡ Compt. Rend. Soc. Biol., lvi. (1904) pp. 736–7. See also Ann. Mycol., iii. (1905) p. 301.

BUCHOLZ, FEODOR.—**Nachträgliche Bemerkungen zur Verbreitung der Fungi hypogaei in Russland.** (Additional notes on the distribution of underground fungi in Russia.)
[Explanatory notes are given of a number of species. The writer considers that a careful search would prove the frequency and wide distribution of this class of fungi.] *Bull. Soc. Imp. Nat.*, iv. (1904) pp. 335–43.

BUSSE.—**Reisebericht II. der pflanzenpathologischen Expedition des Kolonialwirtschaftlichen Komitees nach Westafrika.** (Travel report II. of the plant pathological expedition of the Colonial Administrative Committee to West Africa.)
[Special attention is given to the culture of cotton, and to the extent to which it is affected by parasitic fungi.]
Tropenpflanzer, ix. (1905) heft 4, pp. 169–84 (2 figs.).
See also *Centralbl. Bakt.*, xiv. (1905) p. 743.

BUTLER, E. T.—**The Indian Wheat Rust Problem: Part I.**
[An account of wheat rust disease in India, with suggestions as to the means of combating the disease.]
Dept. Agric. India, Bull. I. (Calcutta, 1903) 18 pp.

EARLE, F. S.—**Mycological Studies: II.**
[New species collected in Western America by C. F. Baker, and new tropical fungi collected by A. A. Heller at Porto Rico.]
Bull. New York Bot. Gard., iii. (1905) pp. 289–312.
See also *Ann. Mycol.*, iii. (1905) p. 292.

ELLIS, J. B.—**A new Rosellinia from Nicaragua, Rosellinia Bakeri.**
[The fungus was growing on wood.] *Torreya*, v. (1905) p. 87.

HAFNER, B.—**Einige Beiträge zur Kenntniss des Invertions der Hefe.** (Some contributions to the knowledge of the "inversion" of Yeast.)
Zeitschr. Physiolog. Chemie, xlii. (1904) p. 1.
See also *Bot. Centralbl.*, xcviii. (1905) pp. 653–4.

HENNEBERG, W.—**Abnorme Zellenformen bei Kulturhefen.** (Abnormal cell-forms in yeast culture.)
[The abnormal cells have only a short duration: they are round, broad, or amœba-like.] *Wochenschr. Brauerei*, xxi. (1904) pp. 563–79.
See also *Ann. Mycol.*, iii. (1905) p. 215.

ISSAJEW, W.—**Ueber die Hefekatalase.** (On Yeast Catalase.)
Zeitschr. Physiol. Chem., xlii. (1904) p. 112.
See also *Bot. Centralbl.*, xcix. (1905) p. 28.

" " **Ueber die Hefeoxydase.** (On Yeast Oxydase.) *Tom. cit.*, p. 132.
See also *Bot. Centralbl.*, xcix. (1905) pp. 28–9.

JAAP, O.—**Verzeichniss zu meinem Exsiccatenwerk "Fungi selecti exsiccati," Serien I.–IV., nebst Bemerkungen.** (List of Fungi, with notes.)
[Several new species of microfungi are included.]
Bot. Ver. Prov. Brandenb., xlvii. (1905) pp. 77–99.
See also *Ann. Mycol.*, iii. (1905) p. 295.

LAER, HENRI VAN.—**Sur quelques levures non inversives.** (On some non-inverting yeasts.)
[The author experimented with species of *Saccharomyces* and *Torula*.]
Centralbl. Bakt., xiv. (1905) pp. 550–6.

LAUBERT, R.—**Die Taschenkrankheit der Zwetschen und ihre Bekämpfung.** Leaf-curl disease of damsons and its cure.)
Kais. Gesundh. Biol. Abt. Land.-Forstw.,
Flugbl. 30, Mar. 1905.
See also *Centralbl. Bakt.*, xiv. (1905) p. 747

LAUBERT, R.—**Eine neue Rosenkrankheit, verursacht durch den Pilz Coniothyrium Wernsdorffiæ.** (A new disease of Roses caused by the fungus *Coniothyrium Wernsdorffiæ.*)
[The fungus attacks the young twigs.]
Arb. Biol. Abt. Land.-Forstw. Kais. Ges., iv. 5 (1905) pp. 458–60 (2 figs.)
See also *Hedwigia*, xliv. (1905) p. 154.

LINDAU, G.—**Beobachtungen über Hyphomyceten: I.** (Observations on Hyphomycetes.)
[The author gives critical notes on species found in Brandenburg, and describes a number of new forms.]
Abh. Bot. Ver. Prov. Brandenb., xlvii. (1905) pp. 67–76.
See also *Hedwigia*, xliv. (1905) p. 148.

LINDNER, P.—**Die Prufung der Hefe auf Homogenität.** (Examination of yeast-cells as to their homogeneity.)
[According to the author, cells of similar size have the same appearance, belong to the same species, and are in the same physiological condition.]
Wochenschr. Brauerei, xxi. (1904) p. 621.
See also *Ann. Mycol.*, iii. (1905) p. 215.

MAZE, P.—**Microbiologie agricole. Sur l'Oidium lactis et la maturation de la crème des fromages.** (Agricultural microbiology. Note on *Oidium lactis* and the ripening of the cream of cheese.) *Comptes Rendus*, cxl. (1905) p. 1812.

PANTANELLI, E.—**Pressione e tensione delle cellule di lievito.** (Pressure and tension of yeast-cells.) *Atti Reale Accad. Lin.*, cccii. (1905) pp. 720–6.

REHM.—**Ascomyceten exsiccat. Fasc. 34.**
[Descriptions are published of the new species or varieties.]
Ann. Mycol. iii. (1905) pp. 224–31.

REICHLING, G. A.—**Contributions to the recorded Fungus and Slime-mould Flora of Long Island.** *Torreya*, v. (1905) pp. 85–7.

RICK, J.—**Pilze aus Rio Grande do Sul.** (Fungi from Rio Grande do Sul.)
[A large number of new species of Basidiomycetes and Ascomycetes are described.] *Ann. Mycol.*, iii. (1905) pp. 235–40.

SHIGA, K.—**Ueber einige Hefefermente.** (Some yeast ferments.)
[Arginase, found only in animals hitherto, has been found in yeast.]
Zeitschr. Physiolog. Chemie, xlii. (1904) p. 502.
See also *Bot. Centralbl.*, xcviii. (1905) p. 657.

SLAUS-KANTSCHIEDER, J.—**Ueber Pflanzenkrankheiten im Gebiet von Spalato.** (Plant diseases in the province of Spalato.)
[The depredations of several parasitic fungi are noted, and curative measures discussed.] *Zeitsch. Land. Versuchsw. Oesterr.*, 1905, p. 274.
See also *Centralbl. Bakt.*, xiv. (1905) p. 743.

SYDOW.—**Mycotheca germanica, Fasc. VII. (No. 301–50).**
[Diagnoses are published of the new species included in the fascicle.]
Ann. Mycol., iii. (1905) pp. 231–4.

TAKAHASHI, T.—**Some New Varieties of Mycoderma Yeast.**
Bull. Coll. Agric. Tokyo, vi. No. 4 (1905) pp. 387–401.
See also *Bot. Centralbl.*, xcix. (1905) p. 9.

THAXTER, ROLAND.—**Preliminary Diagnoses of New Species of Laboulbeniaceæ: VI.**
[There is one new genus, *Districhomyces*, recorded; many new species are described.] *Proc. Amer. Acad. Arts and Sci.*, xli. (1905) pp. 303–18.

TRAVERSO, G. B.—**Secondo contributio allo studio della Flora micologica della provincia di Como.** (Second contribution to the study of the mycological flora of the province of Como.)
[Eighty-one species of microfungi are recorded; there is one new species included in the list.] *Malpighia*, xix. (1905) pp. 131–52.

WEHMER, C.—Versuche über Mucorineengärung. (Research on fermentation by *Mucor*.)

[The research was carried on under varying conditions of media and aëration, and the different results are noted. *Mucor javanicus* and *M. racemosus* were used in the cultures.] *Centralbl. Bakt.*, xiv. (1905) pp. 556–72.

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Lichens of Finisterre.*—Picquenard prefaces his list of Finisterre lichens by an account of the distribution of these plants in the immediate neighbourhood. He also discusses the influence of climate and altitude, and compares the lichen flora of the district with that of other parts of the country. He finds certain maritime forms, such as *Physcia flavicans* and *Ramalina scopulorum*, growing on rocks far in the interior, and he explains their presence by the action of the wind, which has disseminated these species. He follows the methods of classification adopted by Boistel. Most of the species recorded have been collected by himself, or by colleagues working with him, but he has made use of existing herbaria to complete the lists.

Classification of Lichens.†—Albert Schneider writes a paper on the present position of systematic Lichenology. He sums up his views on the question thus :—

1. While some authorities are satisfied that lichens deserve to be recognised as an autonomous group, others are not ready to admit this. This difference of opinion does not cause any serious confusion in the conception of lichen groups and species.

2. There is great confusion with regard to the limitation of lichen species. The number of good species is in all probability about 4000. The number actually described of species, varieties, and forms, is about 20,000.

3. The system of classification proposed by Zahlbruckner, in Engler and Prantl's "Pflanzenfamilien" is excellent, and should be generally adopted. This would very materially facilitate the work of studying the various groups more carefully, thus perfecting our knowledge of lichens more and more, and making it possible to form a more perfect system in the near future.

Schneider considers that Zahlbruckner gives too much systematic importance to the thecial characters.

Lichen Flora in the Neighbourhood of Amberg.‡ — Michael Lederer has collected Lichens near Amberg in Bavaria for some years, and has found 75 genera, 220 species, and 54 forms. The country round was on the whole rather unfavourable, as there are no old rocks, and large forests of beech and fir are wanting. He arranges them as shrubby, leafy, and crustaceous forms, the latter including the largest

* Bull. Acad internat. Géogr. botan., Le Mans, 1904, 132 pp. See also Bot. Centralbl., xcviii. (1905) pp. 657–8.

† Torreya, v. (1905) pp. 79–82. ‡ Ann. Mycol., iii. (1905) pp. 257–84.

number of plants. He gives helpful notes on many of the species, summing them up in many instances into easily distinguishable groups.

Lichen Cephalodia.*—L'Abbe Hue has found, on examining *Parmelia cæcophora*, from Chili, that there were two plants included under the same name, like each other in outward appearances, but differing in the fruit. The one has rather small apothecia, with colourless three-celled spores; the other has larger fruits and large simple spores. Hue found, on these Lichens, cephalodia which contained bright green algæ associated with the blue-green. In one case the alga was a *Glæocystis*, in the other *Urococcus*. All other recorded forms of cephalodia contain blue-green algæ alone.

Polymorphism of Evernia furfuracea.†—A. Elenkin declares himself to be fully in accord with Zopf, Nylander, and Wainio as to the importance of purely chemical characters in Lichens. He considers that such characters are sufficient to differentiate species even when there is no morphological distinction. One condition, however, is necessary, that the reaction from the chemical test should be constant. He applies this to the examination of *Evernia furfuracea*, divided by Zopf into five chemical species, without morphologically distinct characters. In hundreds of his specimens he found olivetor acid, which, according to Zopf, is found only in *Evernia olivetorina*. In other specimens of Scobicina type, he found furfuracin, which is confined to *E. isidiophora*. These results, and also the fact that olivetor acid was found in very varying quantities, have led Elenkin to consider Zopf's species, *E. furfuracea*, *E. isidiophora*, *E. ceratea*, and *E. olivetorina*, as one and the same species. *E. soralifera*, he thinks, may perhaps be distinct from the others.

Lichenology for Beginners.‡—F. Le Roy Sargent publishes the second of a series of papers intended as an introduction to the field study of Lichens. He selects a common form of *Parmelia*, and instructs the student as to the meaning of the terms used in describing such a Lichen, and he also explains the structure and function of the thallus and fruit.

In another paper, by Bruce Fink § on similar lines, the macroscopic characters of the Lichen are chiefly dealt with—the different forms of thallus that exist in this group of plants, their size, colour, and texture. He emphasises the various points that are constant, and that have a bearing on classification.

An elementary guide to Lichenology,‖ accompanied by typical specimens of the plants, has recently been issued by Abbé Harmand, with the help of H. and V. Claudel. Their aim is to enable the beginner to indentify the Lichens that occur most frequently. The

* Ann. Assoc. Nat. Levallois-Perret, 1904, pp. 31–41. See also Bot. Centralbl., xcix. (1905) pp. 34–5.
† Bull. Jard. Imp. bot. St. Petersburg, v. (1905) p. 9–22. (Russian.) See also Hedwigia, xliv. (1905) pp. 151–2.
‡ Bryologist, viii. (1905) pp. 66–9 (5 figs.). § Tom. cit., pp. 73–6.
‖ Epinal, 1904, 106 pp., 1 pl. See also Bot. Centralbl., xcix. (1905) pp. 68–9.

authors publish a general account of the plants, and instructions how to gather and examine them. Then follow tables of the families, tribes, and genera into which they are divided. Under each genus one or two species are carefully described, sufficiently so to enable the student to identify the Lichen, especially when aided by the dried specimens.

BOULY DE LESDAIN.—**Liste des Lichens recueillis à Spa.** (List of Lichens collected at Spa.)
[The list includes 188 species of Lichens. Two new species of *Lecidea* are described.] *Bull. Soc. Bot. France*, lii. (1905) 23 pp.
See also *Bot. Centralbl.*, xcix. (1905) pp. 33–4.

CHEEL, E.—**Bibliography of Australian Lichens.**
[A complete list of papers on this subject published prior to September 1903.]
Journ. and Proc. Roy. Soc. N. S. Wales, xxxvii. (1903) pp. 172–82.

„ „ **List of Lichens found in New South Wales.**
[The list is additional to those recorded in F. R. M. Wilson's list.]
Proc. Linn. Soc. N.S.W. (1903) pp. 687–90.

CUFFINO, LUIGI.—**Osservazione e aggiunte alla Flora del Canada.** (Observations and additions to the Flora of Canada.)
[A small number of Lichens are included in the list, collected in British Columbia.] *Malpighia*, xix. (1905) p. 196.

DUSS, R. T.—**Les principaux Lichens de la Guadeloupe.** (The principal Lichens of Guadeloupe.)
[The plants were collected by R. T. Duss and determined by Wainio. The abundance of species of *Graphis* is noted.]
See *Bot. Centralbl.*, xcviii. (1905) p. 657.

JATTA, A.—**Licheni essotici dell' Erbario Levier raccolti nell' Asia meridionale, nell' Oceania, nel Brasile, e nel Madagascar. Serie ii.** (Exotic Lichens from the Levier Herbarium, collected in Southern Asia, Oceania, Brazil and Madagascar.)
[One hundred and fifty species are recorded; there are several new species and varieties.] *Malpighia*, xix. (1905) pp. 163–86.

WAINIO, EDV. A.—**Lichenes ab Ove Paulsen praecipue in provincia Ferghana (Asia Media) et a Boris Fedtschenko in Tjanschen anno 1898–1899 collecti.** (Lichens from Central Asia.)
[Thirty-eight species are recorded; several of these are new.]
Bot. Tidsskr. xxvi., Heft 2 (Copenhagen, 1904) pp. 241–50.
See also *Bot. Centralbl.*, xcviii. (1905) p. 603.

Schizophyta.

Schizomycetes.

New Colourless Thiospirillum.* — W. Omelianski describes this organism, to which he gives the name of *Thiospirillum Winogradsky*. It developed in a tall cylinder in which, beneath a layer of fluidity, was lime mud mixed with gypsum and a small quantity of vegetable refuse; the cylinder was filled to the brim with tap water, and stood in a shady place. After several months a zone of the sulphur bacterium appeared in the lower third of the vessel. It is a large, faintly brownish-green coloured spirillum, with active screw-like motility; its colour depends on the highly refractile drops of sulphur with which the body is dis-

* Centralbl. Bakt., 2te Abt., xiv. (1905) p. 769.

tended; the flagella could not be stained, and their position at one or both ends of the organism could not therefore with certainty be determined; the length of the spirillum varies up to 50 μ, its breadth being about 3 μ. Since it is not coloured by bacterio-purpurin like the other sulphur bacteria, he considers that this spirillum should be classed as an independent variety.

Bacillus macerus, an Acetone-forming Bacillus.*—F. Schardinger found this organism as an accidental contamination in a potato medium that had been sterilised for an hour on three successive days in a current of steam, an unexpected fermentation occurring on incubating at 37° C.; he also found the bacillus in the mud of retting flax. The organism appears as slender, actively motile rods 4 μ–6 μ long, 0·8 μ–1 μ broad; when mature and in the sporing stage they are non-motile; the spores are situated at one end of the rod; the ripe spores are oval, 2 μ long, 1·8 μ broad; they are very resistant to the temperature of boiling water. On nutrient gelatin plates with 3 p.c. dextrose, white pin-point colonies appear after about 8 days; in gelatin stab there is but feeble growth in the track, no gas formation, no liquefaction of the medium; on sugar bouillon at 37° C. there is rapid and abundant growth, diffuse clouding of the medium, and formation of a slimy deposit; milk is coagulated at 37° C. within 36–48 hours, the separated serum is clouded, and there is abundant gas production; on boiled potato at 37° C. there is a vigorous moist shining growth, with copious gas production, which after a few days gives off a pleasant fruity odour of acetone, the potato becoming pappy; microscopically the mass is seen to be rich in spores. The author discusses the process of retting in various vegetables and fruits, and gives details of the methods employed by him for obtaining acetone from potato and other plants and fruits by means of this organism, and for quantitatively estimating the acetone formed.

Bacterial Rods of Pelomyxa Palustris.†—L. J. Veley describes the bacterial nature of the rods of *Pelomyxa Palustris* as evidenced by their motility, mode of division, their reaction, and culture. To observe the motility the protozoon was crushed in a drop of water and the bacteria being set free were watched continuously for periods of several hours without removing the eye from the Microscope. The movement, which was both horizontal and vertical, was at first active but became sluggish, and later ceased; the presence of a flagellum could not with certainty be demonstrated. The division of the organism was observed by a similar method of continuous watching; on several occasions single rods were seen to become constricted, forming two equal joints, one of these again becoming constricted and so forming a three-jointed rod, and so on till a six-jointed rod was produced, when separation occurred by breaking into two; but in no instance was a single unit set free. The rods stained well with all bacterial stains and by Gram's method. After several attempts, an approximately pure culture was obtained on fresh sheep's serum; the culture showed motile, two-jointed rods: later filaments were formed, and "pseudo-branching" of these was also noted.

* Centralbl. Bakt., 2te Abt., xiv. (1905) p. 772.
† Journ. Linn. Soc., xxix. (1905) p. 374.

Virulence and Immunising Powers of Micro-organisms.*—R. P. Strong investigated the essential differences existing between two strains of cholera spirilla of different degrees of virulence, particularly in relation to the subject of their virulence and to the immunity to which they give rise in inoculated animals. He found that the virulent cholera spirillum possesses a greater number of bacteriolytic and agglutinable haptophore groups, or these groups are endowed with a greater binding power for uniceptors and amboceptors than the avirulent; the number or the avidity of the bacteriolytic receptors possessed by a bacterium is directly proportional to its virulence; but the agglutinable receptors do not follow this law, the agglutinable haptophore groups are not necessarily present in the same proportion as the bactericidal ones. The virulent organism is possessed with a greater number of toxic haptophore groups than the nonvirulent. The binding power of the free receptors of the organisms for bacteriolytic amboceptors in vitro is proportional to the bactericidal immunity produced in animals by each, which latter is in turn proportional to the virulence of the organisms from which the receptors were extracted. The binding power in vitro of the dead micro-organisms of different virulence for bacteriolytic amboceptors is not in proportion to their toxicity. The bactericidal immunity obtained by means of the inoculation with dead organisms of different virulence or their extracts (obtained by autolytic digestion) is proportional to the virulence of the living strains of the bacteria employed. With the living organisms, while the bactericidal immunity obtained from the inoculation of animals with the virulent organism is greater than that produced with the non-virulent, such immunity is not in direct proportion to the virulence of the bacteria introduced.

Bacillus Freudenreichii.†—F. Lohnis, in his account of the nitrogen bacteria, gives the following description of *Bacillus Freudenreichii* Migula. Slender round-ended rods 1μ broad, 2μ–4μ long, having a tendency to form threads; they stain well by the ordinary dyes, and by Gram's method; in young cultures the rods are actively motile, having numerous long peritrichous flagella; spore formation is especially well seen on old potato cultures, the spores being small, elliptical (1μ–$1 \cdot 25\mu$) and tending to lie nearer to one pole; on ordinary gelatin plate growth is relatively slow, the small surface colonies are white and blue by transmitted light, round and rather ragged, of the colon type but much smaller; the centre portion is yellowish and finely granular, the margin sharply defined; after ten days the colony has a diameter of about 320μ; the round, sharply contoured, yellow, deep colonies remain small; on urea-gelatin plates similar colonies develop, but the growth is quicker, the colonies having a diameter of 110μ–130μ after four days. In gelatin stab cultures the growth is irregular; at one time, even after 10 days, only a fine grey thread is noticeable in the track of the stab, and growth on the surface has ceased; whereas on another occasion, with rather more alkaline gelatin, a fine milky thread is seen after four days, and on the surface a white transparent membrane with ragged margin, which after

* Bureau Gov. Lab. Manila, 1904, No. 21.
† Centralbl. Bakt., 2te Abt., xiv. (1905) p. 719.

10 days sinks in the bubble of liquefaction; in urea-gelatin stab cultures there is a more vigorous growth of the white-grey thread reaching to the bottom of the track, on the surface a white expansion, which after 8–10 days is ½ cm.–¾ cm. broad, has a fringed margin, and sinks as the slow liquefaction appears, but after 14 days the gelatin is still firm. On agar streak a spreading white-grey, moist, shining growth with ragged fringed margins; on urea-agar streak there grows a thin, finely granular, milky, transparent expansion of low vitality; subcultures after 14 days are unsuccessful. In broth there is a slow appearance of cloudiness without ring or pellicle formation, a white-grey powdery, later rather slimy, deposit; slight indol production. In milk cultures the chief changes to note are slight clearing and more alkaline reaction; no special peptonising of the casein was observed after several weeks at room temperature. The growth on potato is slow, and at first hardly to be distinguished from the medium, but after about 10 days there is a colourless faintly shining expansion, becoming slimy later and of a flesh to brown colour.

Decomposition of Albuminoids by Cladothrix Chromogenes.*—M. E. Macé finds that *Cladothrix chromogenes* grows well in liquid blood serum, colouring the medium a deep brown, and producing that peculiar odour that is characteristic of this group of organisms. After a few months the medium has become more fluid and no longer coagulates by heat, but gives on boiling a heavy flocculent precipitate. This liquid contains ammonia and pro-peptones, but no indol; it forms an abundant white crystalline deposit, which on shaking has a shining spangly aspect; the crystals consist of tyrosin, leucin, and glycocol.

Bacteriology of Appendicitis.†—Perrone obtains drops of liquid aseptically from the interior of the appendix immediately after the operation, and after preparing direct specimens to ascertain the relative abundance of microbes in the liquid, he makes progressive dilutions into 10 tubes of broth, and with 1 c.cm. from each of these he inoculates 10 tubes of sloped agar, for aerobic culture, and 10 tubes of sugar-agar for anaerobic culture. As soon as the colonies begin to be visible they are isolated and subcultured on agar and broth. He gives clinical, pathological, and bacteriological details of 14 cases. He found *B. coli* in 10; *Diplostreptococcus* of Tavel in 6; *Streptococcus pyogenes* in 4; *B. fragilis* of Veillon and Zuber in 7; *B. perfringens*, an almost strict anaerobe, in 6; *B. proteus* in 2; and *Pneumococcus*, *Staphylococcus*, *B. pyocyaneus*, and *B. fusiformis*, each in 1 case. The appendix was found sterile in 1 case. He notes and lays great stress on the preponderance of anaerobes over aerobes, and does not share the opinion of many authors that the *B. coli* is the pathogenic organism of appendicitis.

Micro-Organisms in the Intestines of Infants.‡—A. Rodella finds that in the intestines of infants various peptonising microbes are found; that they are more numerous in bottle-fed children, and that the anaerobic conditions in no way hinder the peptonisation of the casein. As the result of many observations, he concludes that the action of trypsin on albuminoids is not hindered by acids. He differs from

* Comptes Rendus, cxli. (1905) p. 147.
† Ann. Inst. Pasteur, xix. (1905) p. 667. ‡ Tom. cit., p. 406.

M. Tissier in considering that the circumstances favourable to the establishment of putrefaction, such as fermentation in an alkaline medium, are also favourable to the production of a maximum number of spore-forming micro-organisms.

Micro-organisms of Cheese Making.*—P. Mazé discusses the nature and the comparative uses of the various micro-organisms occurring in the manufacture of different kinds of cheese. He refers especially to three varieties of *Penicillium*, *P. glaucum*, *P. candidum*, and *P. album*; this last occurs in the refined cheeses, and is most important from its property of destroying lactic acid and lactose, and may be regarded as an obligate intermediary between the lactic fermentation necessary to the cheese making, and the casein ferment indispensable to the refining process, since the casein ferments cannot develop in the presence of acids; the characteristic flavour of Brie and Camembert cheeses being due to this mould; it is apparently of use in obviating the drying of the surface, and in maintaining the porosity of the cheese.

Two Varieties of Vibrio aquatilis fluorescens.†— F. Fuhrmann describes two varieties of fluorescent water vibrios: (*a*) was isolated from surface water; (*b*) was obtained from cistern water.

(*a*) Grows well on nutrient gelatin at room temperature, forming round, sharply contoured colonies, with denser central portions, and of a faint yellow colour; after a few days a green fluorescence is diffused throughout the medium, which after a week remains unliquefied; the colonies are composed of long, slender, slightly curved rods, with characteristic active vibrio movement; they stain as well with aqueous fuchsin as with gentian-violet solution, but not by Gram's method; the optimum temperature is 32° C., and when grown on agar at this temperature the rods are shorter and stouter, and preparations show 3–5 polar flagella; it forms a brown-yellow growth on potato, and a light brown growth on white of egg, which, after two months, is converted into an amber-brown transparent mass; in nutrient broth there is good growth, with the formation of a strong pellicle, but no great tendency to thread formation; in pepton-water there is not good growth, and no pellicle is formed; in a fermentation flask there is clouding of glucose broth, but no production of gas. It grows best on slightly alkaline medium (0·5 p.c. N); it grows in litmus milk, and after five days at 22° C., it forms 2 p.c. N/10 acid. A dose of 15 mgrm. was pathogenic for guinea-pigs when injected into the peritoneum; white mice and rabbits were unaffected.

(*b*) Grows on nutrient gelatin as circular almost transparent colonies cupped in the centre, and with delicate wavy margins; the medium is not liquefied; fluorescence commences after 24 hours; the colonies are composed of closely arranged rods, which are slightly curved, about $1 \cdot 5\,\mu$–$2\,\mu$ long; they stain like the first variety, and not by Gram's method; they are actively motile, and preparations made from agar culture show 2–3 polar flagella; the optimum temperature is 22° C. On potato and on white of egg the growths are the same as with the other variety; in nutrient broth there is good growth at room tempera-

* Ann. Inst. Pasteur, xix. (1905) p. 378.
† Centralbl. Bakt., 2te Abt., xiv. (1905) p. 641.

ture, with the formation of long threads composed of over fifty members. It grows best on slightly alkaline medium (1 p.c. N); in litmus milk at 22° C. after 5 days it forms 1 p.c. N/10 alkali. It is pathogenic for guinea-pigs when injected into the peritoneum. It produces a toxin which can be extracted from the dead cultures, and which is fatal for guinea-pigs in relatively small doses.

Differentiation of the Human and Bovine Tubercle bacillus.* Th. Smith finds that if these bacilli are grown in glycerin broth, titrated against phenolphthalein to 2 p.c. normal acid, during the first two weeks both cultures tend more and more towards the neutral point, but later the culture of the human bacillus, which has become about 0·3 p.c. acid, again becomes more acid, and eventually regains its original reaction; whereas the culture of the bovine tubercle bacillus becomes distinctly alkaline, and retains this reaction.

* Centralbl. Bakt., Ref., 1te Abt., xxxvi. (1905) p. 654.

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Old [illegible]scope by [illegible] presented by Mr. C. [illegible] and is a modification of [illegible] The pin supporting the [illegible] pillar, but the stage [illegible]

[illegible]

pillar moved by rack-and-pinion for focusing. In Ellis's Aquatic Microscope the stem for carrying the lens-holder passes through a socket at the back of the pillar, but in the instrument it passes down a hole in the centre of the inner pillar. These alterations in the original design were referred to by Adams in his Essays on the Microscope (1787). Another alteration was the making of the stage removable to economise space in the case. There are six lenses, two being provided with lieberkühns.

The case is covered with red leather instead of the fish-skin so commonly used at that period. The instrument was said by the dealer who sold it many years ago to have been the celebrated Dr. Jenner's Pocket Microscope.

A very similar Microscope made by Bate was presented to the Society by Mr. E. B. Stringer, and is figured and described in the Journal for 1904, p. 354.

Pocket Botanical and Universal Microscope. — This instrument (fig. 139) was presented to the Society by Mr. C. Lees Curties. It was

FIG. 139.

made by W. and S. Jones, and is figured and described in Adams' Essays on the Microscope, 2nd Edition, 1798, as a Pocket Botanical and Universal Microscope. It is evidently an improved form of the "Common Botanical Microscope," described in the first edition of Adams' work, 1787, which had only two lenses and no adjustment screw to move the stage. This example is well and neatly made, has three lenses which can be superposed one over the other, and also a focusing screw which is clamped to the stem and moves the stage. The stem slides in a square brass socket screwed on to an oval ebony base.

Wilson Screw-Barrel Simple Microscope. — This instrument (fig. 140) was presented by Mr. C. Lees Curties and was exhibited with the

two previously described at the June meeting. It is of ivory, and, though bearing no maker's name, was probably made by Adams about 1746. There are seven object glasses, a lens-carrier for opaque work,

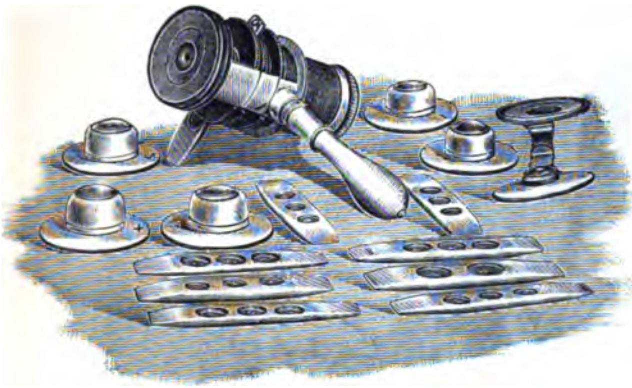

FIG. 140.

and nine ivory object slides. A light condensing lens is mounted on a brass slide just below the object slide.

Horizontal Travelling Microscope.*—This instrument (fig. 141) made by the Cambridge Scientific Instrument Company, is for measuring

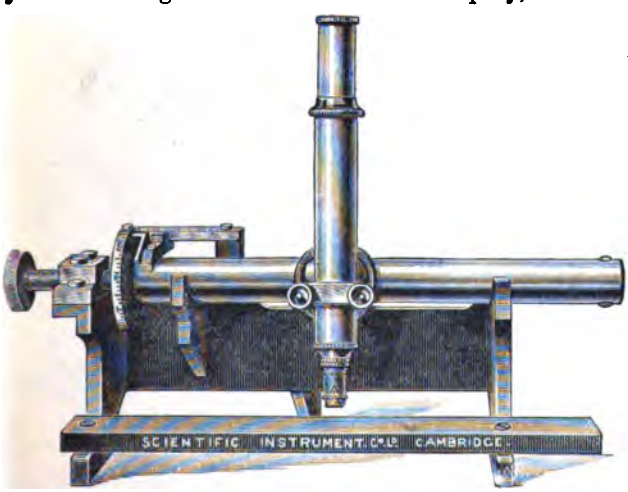

FIG. 141.

small differences of length. A vertical Microscope is fixed to a carriage mounted on a geometric slide and is moved in a horizontal direction by a micrometer screwreading to 0·1 mm.

* Catalogue Optical Convention, 1905, p. 219, fig. 11.

FIG. 142.

Pillischer's New Model "Kosmos."*—This instrument (fig. 142) has the following features: a substantial solid and firm stand, having rack-and-pinion course adjustment; micrometer screw fine adjustment; substage with centring screws and rack-and-pinion focusing adjustment; new form of sliding pinhole diaphragm and iris diaphragm; two eye-pieces; $\frac{2}{3}$, $\frac{1}{7}$ and $\frac{1}{8}$ objectives; and Abbe condenser 1·20 N.A.

Microscope specially adapted for Mineralogical Investigations at High Temperatures.†—E. Sommerfeldt has designed this instrument to meet the difficulties felt in applying heating chambers to mineralogical Microscopes, as it is usually found that such chambers interfere with the rotatory arrangements of the Microscope. C. Leiss has, it is true, made some models intended to overcome the difficulty, but at the disadvantage of complications. E. Sommerfeldt, therefore, aims at simplicity. In

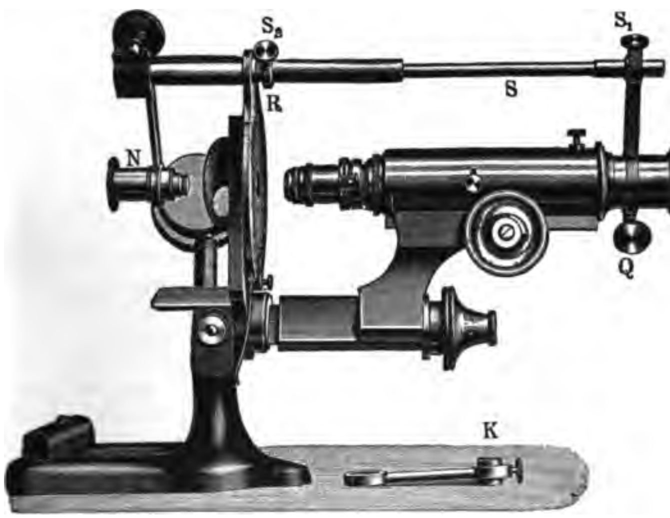

FIG. 143.

his apparatus, fig. 143, the same rotation axis and the same divided circle suffice for the rotation of both object-stage and Nicol prisms. The rotatory object-stage consists of a strong divided circle, which is surrounded by a ring R carrying the vernier, while perpendicularly to its object plane the ring carries a rod S, to one of whose ends is attached a rack-and-pinion movement for the polariser N, and the other, by means of an adjustable cross-rod, grips the ocular collar at S_1; this arrangement makes possible a rotation of object-stage and polariser about the axis of the instrument. In order to follow the movement of the tube during the adjustment, either the screw S_1 or the screw S_2, which move along grooves, should be loosened. For measurement of angles of rotation, these screws are naturally clamped. The rod S and cross-rod Q can,

* Catalogue Optical Convention, 1905, p. 116, fig. 25.
† Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 181–5 (1 fig.).

if required, be completely removed. In order to connect a preparation in the central part of the object-stage circle with the peripheral ring and vernier, a transparent plate is firmly attached to the latter, and covers over the divided circle. In ordinary cases this transparent plate would be of glass, but, for heated objects, it is replaced by one of mica. The object to be viewed is set in a special clamp K, to be secured to the rod S. It may easily happen that the clamp holding the preparation may press the mica plate hard on to the divided circle; but, although this difficulty could have been easily met, the author considers that with heating arrangements it is advantageous that rotation of the Nicol should take place under a tight grip, as it were, of the preparation. The projecting part of the object-stage not only carries the rod S, but secures that the latter shall not, in its rotation, interfere with the mirror.

Hirschwald's New Microscope Model and Planimeter-Ocular.*—This instrument is made by R. Fuess, of Steglitz, Berlin, and is shown in fig. 144. An essential difference between this new model and Microscopes hitherto made with combined Nicol-rotation consists in that the Nicol rotated is not an analyser placed over the ocular, but that an analyser inserted at N in the tube is rotated at the same time with the polariser. A disadvantage of the ordinary ocular-analyser clearly is that the field of view (i.e. the focal distance of the ocular used) is pushed back on account of the lengthened eye-distance of the Nicol; this results in a more or less intense diminution of the field. But the new construction allows the rotation of the *inner* analyser only (the analogue of the ordinary ocular-analyser) relative either to the stationary polariser P, or to the preparation, stationary or rotatory, on the object stage T. In both cases the ocular and analyser rotate and the ocular-threads mark the rotation-directions of the Nicol. The design also permits of two other controlling movements, less frequently required: the analyser may move *relatively* to the stationary polariser and ocular; or, the polariser may move *relatively* to the analyser and ocular. For these combinations the requisite arrangements are as follows:—

(*a*) *Polariser, Analyser, and Ocular rotate in unison.* The screw-head *b*, under the stage T, is loosened. A connecting screw is inserted in the large ocular rim T_1. The arm *o*, appended to the vernier arm *s* and rotatory about a hinge, is unlocked. For orientating the ocular there are two lines scored on the ocular mount-collar T_1.

(*b*) *Polariser remains stationary, Analyser and Ocular rotate.* To carry out this movement the Nicol circle T_1 must be set at zero, the screw-head *b* under the stage is tightened, and the screw on the Nicol circle T_1 loosened. The arm *o* is unlocked. Rotation takes place on the rim of the Nicol circle T_1.

(*c*) *Polariser and Analyser rotate in unison and the Ocular remains stationary.* The arrangement is the same as for *a*, but the arm *o* is locked over the projecting screw on the ocular.

(*d*) *Polariser and Ocular remain stationary and Analyser rotates.* The arrangement is the same as for *b*, but the arm *o* is locked up as in last.

* Zentralbl. f. Mineral, 1904, p. 626; Zeit. f. Instrumentenk., xxiv. (1904) pp. 367–8 (2 figs.).

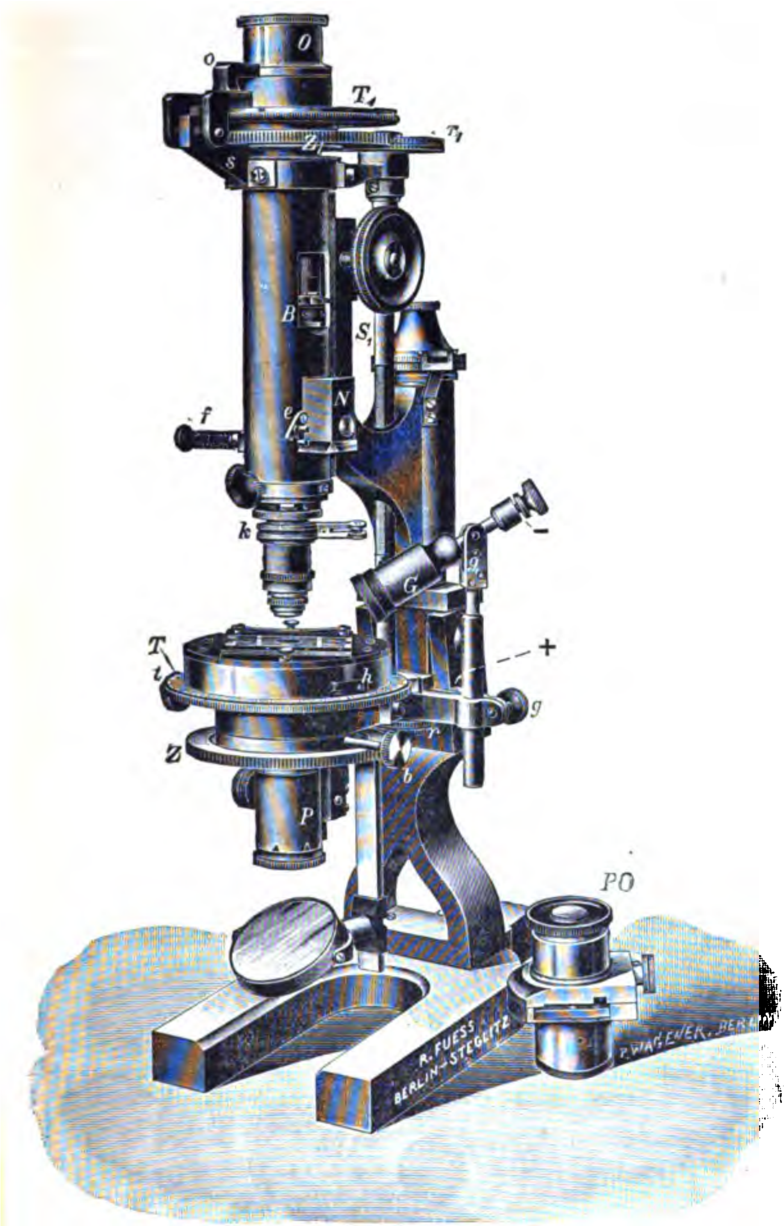

FIG. 144.

The *Observation Oculars* used have an enlarged field of view about double the extent of ordinary oculars. In their image plane is a disc with a round and a square diaphragm, so that a round or a square periphery can, as desired, be given to the image. The latter serves for the quicker enumeration of constituent parts in any section. The other arrangements are practically identical with those of ordinary large polarisation-microscopes. The object stage T and the Nicol circle T_1 are graduated in degrees and their verniers read to 5 minutes. The Bertrand lens B and the analysing Nicol N can be cut out of the pencil of rays; the latter by means of the spring rod *f*; the former by means of a small clip swung back during rotation. The tooth-wheel gear has the well-known arrangement for avoiding dead-way in the teeth.* In lieu of the cross-slit stage this instrument has for swift investigation of a section a simple slide arrangement, by means of which a slide can be pushed by hand-motion freely in two rectangular directions. For upper-surface illumination an adjustable holder for an electric glow-lamp G can be installed near the object stage.

The *Planimeter-Ocular* is seen at P O in the right of fig. 144. It is

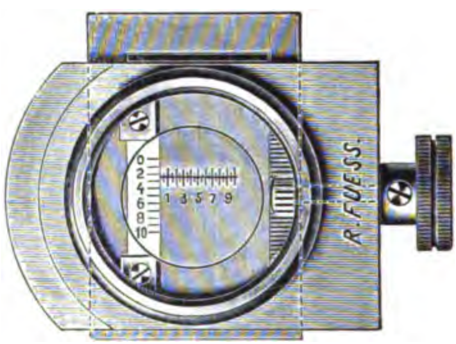

FIG. 145.

used for determining the volume-proportion of any mineral constituents in a thin rock-section. In the image-plane of the ocular two micrometer scales (fig. 145) perpendicular to each other are cut on glass. They serve to give ordinates and abscissæ; the scale for the former being fixed; the latter adjustable by rack-and-pinion. Their combined motions explore a space of one square cm. The planimeter-ocular is applied in such a way that corresponding to the grain of the rock the abscissæ are adjusted on a particular graduation of the ordinates and the condensation index is read off for the various parts. The section is then rotated, or the planimeter-ocular rotated, through 90°, and the reading repeated in the perpendicular direction.

Microphotoscope, or Military Staff Map Loup.†—This arrangement is designed by its inventor, O. Vollbehr, for the avoidance of the in-

* Zeit. f. Instrumentenk., xvi. (1896) p. 17.

† Extract from Kriegstech. Zeitschr., 1905, Heft. 1ᵃ, 12 pp. and 3 figs., Berlin, E. S. Mittler and Sohn; Zeitschr. f. Instrumentenk., xxv. (April 1905) pp. 117–18; Central-Zeit. f. Opt. u. Mech., xxvi. (May 1905) p. 106.

convenience (and for military purposes in front of the enemy, of the dangers) involved in the employment of topographical maps by night or in bad weather. By the aid of the new map-loup small transparent diapositive maps in the shape of about 20 sq. cm. (5 × 4 cm.) are used in lieu of large paper sheets. The microphotoscope can be used by day or by night; in the latter case, the necessary illumination is supplied by a glow-lamp actuated by a dry battery. For the arrangement to work conveniently, the loup must have strong magnification, and the loup-map be of a minimum size. The loup has, at present, been constructed of 13½ fold magnification; it seems scarcely possible to increase this, and, indeed, does not seem necessary. The composition of a sufficiently grainless emulsion for the preparation of the small map diapositives appropriate to the selected magnification has already revealed great difficulties, but these may now be regarded as entirely overcome. The diapositive lies well protected between two glass plates. The loup is, of course, accommodated to the observer's eye, and, moreover, is adjustable over the plane of the diapositive. For a selected position of the loup 175 sq. kilos. would be readable at once on a diapositive of the map of the German Empire (1 : 100,000). Sheets of the map of the German Empire should be first prepared as diapositive loup-maps, afterwards those of the most important foreign topographical maps. On a diapositive a square-meshed net is drawn with sides corresponding to 2½ kilos., so that in all directions estimation of routes and elevations can be made.

Studnicka's Pancratic Preparation Microscope.*—F. K. Studnicka points out that the principle involved in the lens combination described in the previous article, is essentially that of a "pancratic" Microscope. The term is not a new one; pancratic Microscopes were familiar instruments in the first half of the nineteenth century,† and were generally used as dissection-microscopes. They seem to have been found unsatisfactory and to have gradually dropped out of notice. The author, however, thinks that this oblivion is not deserved. He proposes to accurately insert a reversed objective, by means of a simple connecting piece, in the diaphragm-carrier of the Abbe illuminating apparatus, from which the condenser has been removed. Both objectives thus come, in this way, into the approximately proper distance from one another; at most the tube may require to be lowered a little. The side-light is screened off by the side-walls of the upper iris of the illuminating apparatus; the lower objective is fairly close to the object and by rack-and-pinion may be brought still closer to it. The object must be placed on a special stage under the inverted objective, and this stage should be fitted with supports for the hands. Such a stage can be easily improvised out of two pieces of wood and a glass plate. It is possible to use the ordinary stage "pancratically," but the ordinary objective is then inserted at the lower end of the draw-out tube, and the inverted objective fitted to the lower end of the tube (or revolver) with a connecting piece. Tubes with rack-and-pinion movement would be most

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 440–4 (1 fig.).

† *Vide*, e.g. Fischer, Le Microscope pancratique, Moscou, 1841; Hartrig, Das Mikroskop, 1859, pp. 198 and 766. The 'Telemikroskop' of Deschamps (Comptes Rendus, cxxx., 1900) deals with a similar lens-combination.

convenient for this arrangement. On account of the increased working height the author considers this method inferior to the condenser adaptation.

GLATTON—**Right and Wrong Way of using a "Magnifying Glass."**

1. The lens should be held as far from the object as will afford a clear sharp view of it.

2. The eye should be at the same distance from the lens as the latter is from the object.

The advantage of the latter condition is very apparent when examining portraits with a reading glass. I have frequently seen the glass held either close to the eye or close to the paper, both of which are wrong—the latter absurdly so, as no attempt is made to focus the object.

English Mechanic, lxxxi. (1905) pp. 449–50.

(2) Eye-pieces and Objectives.

The Abbe Condenser used as an Objective.*—F. K. Studnicka, after reminding his readers that the condenser of the Abbe illuminating apparatus is an objective reversed, points out that by using it in the latter way, with a proportionally stronger objective, a continuous series of weak magnifications very useful for certain purposes may be obtained. He considers that the cases in which such a method is likely to be useful are :—

1. That preparations can be quickly and simply explored, especially when large (i.e. brain-sections).

2. That the peculiarity of producing graduated magnifications (according to working distance, etc.) will be welcome to an observer who wishes to draw.

3. That it may be made to answer the purpose of a preparation Microscope, and so be economical to an observer.

4. That with the help of the Abbe condenser and the plane mirror an erect Microscope can be easily turned into a horizontal one, and be used as an aquarium Microscope.

5. That the peculiarity of neighbouring objects appearing reduced or enlarged, or even in natural size, facilitates the drawing or copying of objects—the usual drawing apparatus being now combined with the Microscope.

The author illustrates his methods with figures.

Discrepancy between Diffraction Theory and Geometrical Optics in Actual Instances of Telescope and Microscope Objectives.†—K. Strehl has examined an improved achromatic Microscope-objective made by A. Kerber, to test how far the lens performs what theory would have predicted of it. The lens is of 4 mm. focal length and of 0·6 N.A. He is able to state the following discrepancies between diffraction theory and geometrical optics in this particular case :—

1. The wave-surface of the colour C, which in and for itself has the greatest spherical aberration, and, compared with the brightest colour (550 $\mu\mu$), has the maximum chromatic aberration, approximates the most closely to the ideal spherical surface of brightest colour.

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 432–9 (3 figs.).
† Central.-Zeit. f. Opt. u. Mech., xxv. (1904) p. 265.

2. The wave-surface of the colour E, which in and for itself has the second least spherical aberration, and, compared with the brightest colour, the least chromatic aberration, departs the most widely from the ideal spherical surface of the brighest colour.

3. The wave-surfaces of the two colours (C and 550 $\mu\mu$), which for peripheral rays have the least cross-sectional difference, deviate on the periphery the second-furthest from one another.

4. The wave-surfaces of the two colours (D and F), which have the maximum cross-sectional difference for peripheral rays, combine on the periphery.

The following statement may also be enunciated:—

5. Those wave-surfaces of the two colours, E and 550 $\mu\mu$, incline the least to one another from the axis to the periphery, which in the spectrum lie nearest to one another, and, for axial rays, have the least cross-sectional difference.

In support or the foregoing statements the so-called Gauss construction may be appropriately quoted.

6. If the section-distances for axial and peripheral rays of two colours are equally great, then most certainly are the light-paths corresponding to one another from the two wave-surfaces to the image-point not equally long; for (*a*) the medial errors (zones) are in both colours of different magnitude, and therefore also the final result at the periphery. (*b*) The refracted rays of the two colours (direct illumination being pre-supposed) claim different zones (red becomes more strongly refracted than blue).

In another case the author examined a giant objective of over 50 cm. diameter and over 10 cm. focal length. It warranted the following statement (optical paradox).

7. If combined zonal errors were half as great as the actual ones, then the definition-brightness (excellency of image) would be half as great as the reality; if the zonal errors were even less, then, indeed, would the image excellency be rapidly augmented.

K. Strehl hopes that the time may come when no expensive telescope or Microscope objective will be sold without having been submitted to a diffraction theory test. In the case of telescope objectives this would have to be done for each specimen; but in the case of micro-objectives of a given number, the test could be made once for all. Neither can it be objected that the application of the diffraction theory would be too difficult or too tedious. On the contrary, it is quite easy, and at most a specimen would only require two days.

In another journal the author has an article entitled, "Test of a Microscope Objective,"* in which he describes his methods and gives full details of his results.

(3) Illuminating and other Apparatus.

Locking Arrangement for Microscopical Demonstrations.†—A. Fischer has designed an arrangement, more particularly applicable to

* Untersuchung eines Mikroskopobjektives, Zeit. f. Instrumentenk., xxv. (1905) pp. 3–10 (1 fig.).

† Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 100–4 (2 figs.).

the Zeiss No. 1A stand, for preventing interference with the adjustments by inexperienced persons at microscopical demonstrations. The stiff cardboard capsules, which C. Zeiss supplies for covering the milled screw heads of the rack-and-pinion coarse adjustment, the author proposes to unite by a small bent metal bar, and instead of cardboard he would make the caps of brass. The effect is to completely cover up the coarse adjustment, and to place it beyond the risk of displacement. For obtaining similar security with the fine adjustment, he, in the first place, makes the index pointer of rather stouter dimensions than usual, and hinges it so that it can be folded up against the Microscope tube, while

FIG. 146.

the demonstrator is focusing. Two (or more if thought necessary) little pins project 4 mm. about the rotating head of the fine adjustment, so that, when the index is folded down, rotation of more than half a circle is prevented. The observers would thus have a sufficient range within which they could safely vary the focus. It would be best to arrange so that for normal vision the pointer should be midway between the two pins, and to obtain this it might be necessary to make some change in the previous coarse adjustment.

Optical Arc Lamps.*—R. W. Paul makes these lamps in two sizes, for 30 and 60 amperes (fig. 146), the special features being the form of horizontal traverse which gives a firm and even motion; the construction

* Catalogue Optical Convention, 1905, p. 198, fig. 6.

of the carbon holders, which have the terminals cast in one piece with them; and the adjustments for taking up wear in all parts.

Locke's High Power Jet.*—This jet (fig. 147) made by R. W. Paul has a mixing chamber of new design placed next to the inlet valves and connected to the jet by a long delivery tube, thus ensuring perfect mixing of the gases and silence under high pressure.

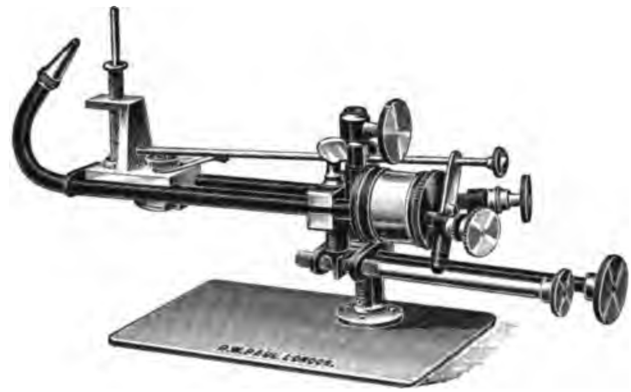

FIG. 147.

Leppin and Masche's Projection Apparatus with Optical Bench Extension.†—The main idea of this apparatus is to produce an initially simple instrument which should be capable of additions as required, so as to render it capable of performing all the most varied purposes expected from such apparatus. Fig. 148 shows the arrangement for simple projection. The iron camera is lined within with asbestos, and has two doors: in addition to the ordinary mode of ventilation there is also a removable outlet for the warm air. The condenser is of 130 mm. diameter. The achromatic Petzval objective has 54 mm. diameter, 130 mm. focal length, and diaphragms. The simple form includes also an object-holder, a stage, and a bench with three riders. Slides of 85 by 100 mm. up to 90 by 120 mm. can be projected, and a magnification of 30–40 diameters attained. Fig. 149 shows the section of the twin rails on which the riders slide. The two prismatic bars, at right angles to each other, give smoothness of motion, security of position, and facility for quick interchange of parts. This arrangement is an essential novelty in the apparatus. Clamping screws are not required, and the time necessary for tightening them consequently saved. The apparatus is installed on a travelling table. It is thought that this mobility will be useful and lead to further economy of time. The height of the table is so designed that projection can be made over the demonstrator's table, and the images received on a screen at a suitable height. Moreover, it is pre-supposed that the apparatus would be stationed near the lecturer's table for use as required, and thus place

* Catalogue Optical Convention, 1905, p. 198, fig. 9.
† Central.-Zeit. f. Opt. u. Mech., xxvi. (April and May 1905) pp. 93–4, 105–6 (6 figs.).

the lecturer beyond the need of a lantern assistant. The table consists of an under part and of a set-back upper part; both parts are of pine

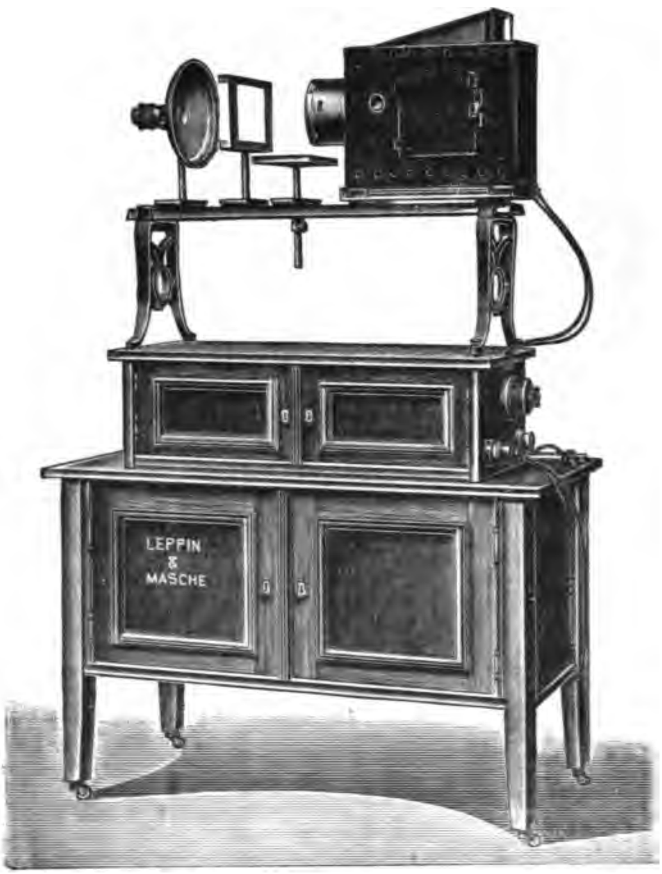

FIG. 148.

wood with oaken tops. The upper part is hinged, in the neighbourhood of the electrical terminals, to the lower, and the opposite face can be raised—this movement would be advantageous in lecturing to a large assembly. Both upper and lower parts are fitted up as cabinets, which are convenient receptacles for the various fittings and auxiliaries. Incandescent gas, acetylene, lime, or electric light can be used, of which the last-named is undoubtedly the best. The makers strongly recommend their self-regulating differential arc lamp in preference to a hand-controlled one. Proper attention must be paid to current strength and resistance.

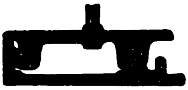

FIG. 149.

To adapt the apparatus to the purposes of microscopic preparations, of a megascope, or of horizontally placed objects, a greater length of optical bench is required. The method of attaining this is shown in fig. 150. Horizontal lateral shelves are drawn out from the ends of the upper part, and by their help a second pair of twin rails is set up and

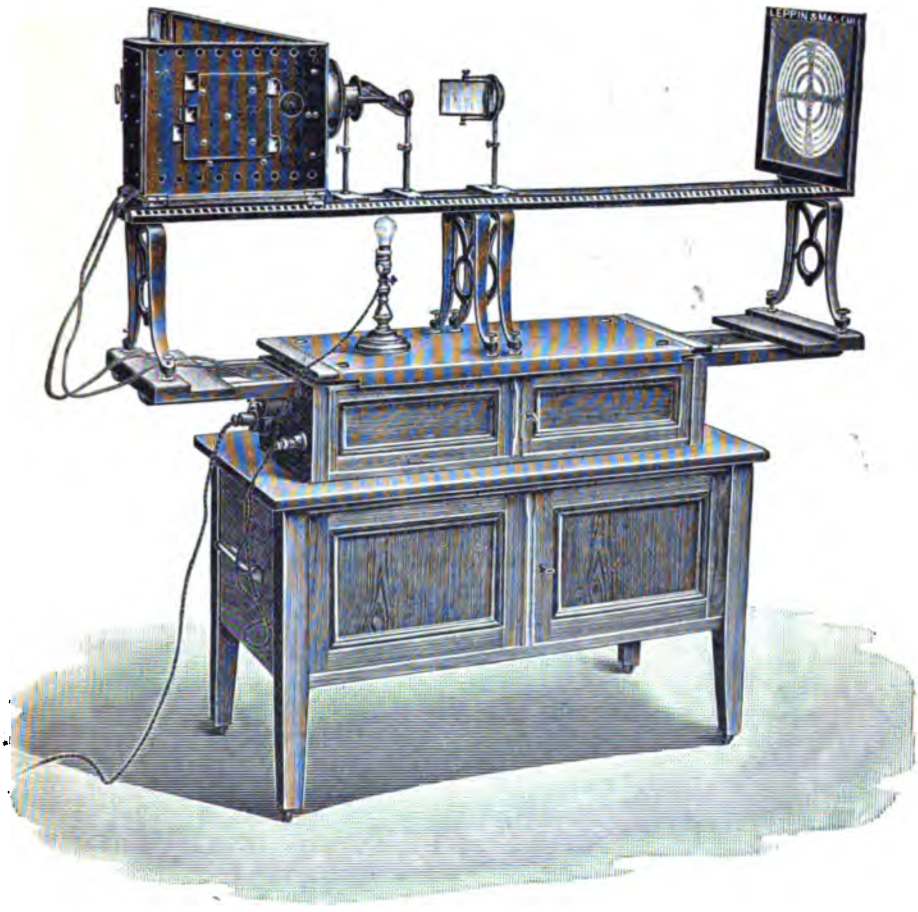

FIG. 150.

combined with the first, so as to give a total bench length of 2 metres. The two sections of bench are rigidly coupled together. It is found that with the proper combination of Nicols and a black mirror polarisation effects are easily attained, and without slanting the camera. For cooling purposes a suitable water-filled large trough with plane-parallel walls is found to answer well; in lengthy investigations the water should be renewed.

Edinger's Projection and Drawing Apparatus.*—As shown in the illustration (fig. 151), this apparatus is an improved form of an older

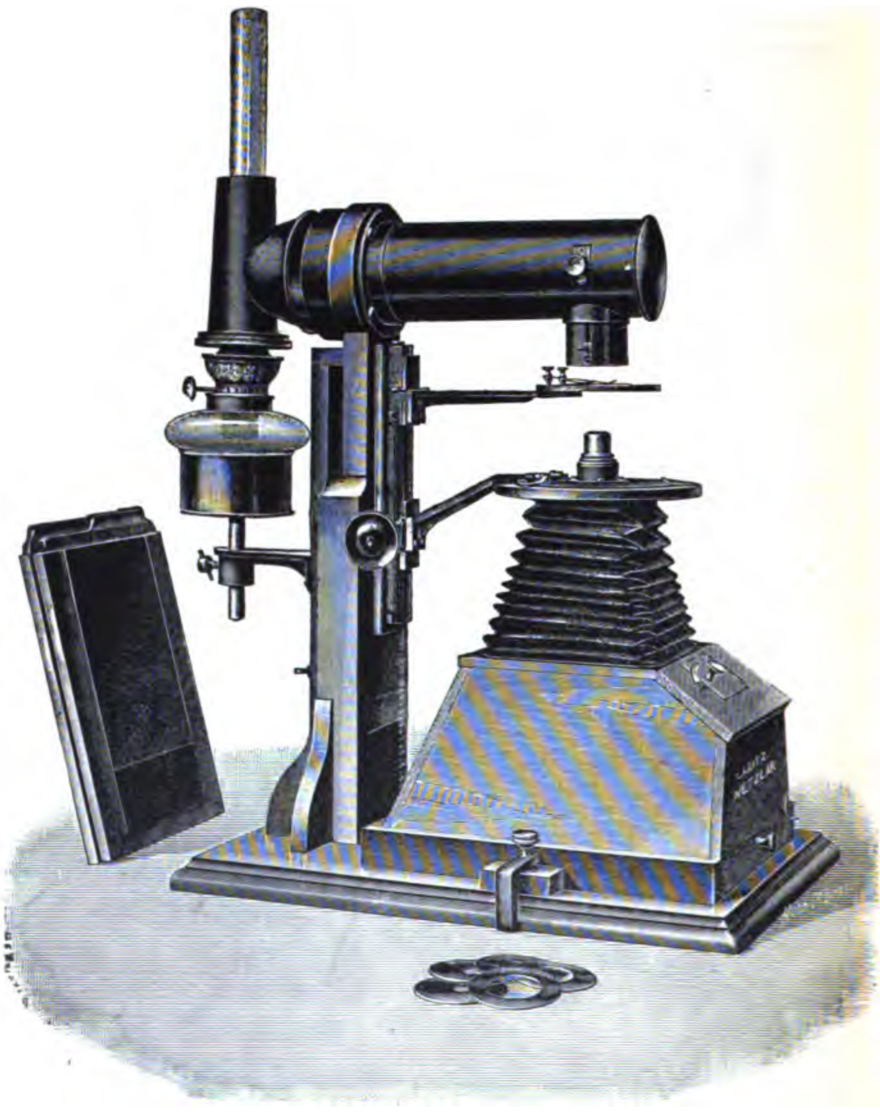

Fig. 151.

type previously described,† and now also adapted for photographic purposes by the addition of Nieser's camera.

* Leitz' Catalogue, No. 41, 1905, p. 98.   † See this Journal, 1891, p. 811.

Simple Apparatus for Drawing and Photographing Microscopical Sections.* —This apparatus, designed by J. Tandler, consists (1) of a drawing-box carrying on its top a photographic bellows; (2) of a box enclosing the light source. The drawing-box is closed in front, open behind, and has a trapezoidal-shaped base of dimensions: rear 65 cm., front 35 cm., width 35 cm. The front wall is strong and 55 cm. high; the back wall (oblique) is not so high, and slopes roof-wise towards the level top. The reason for this shape is that the observer, sitting at the side of the box, may comfortably work with his right arm in the box. In both the front and back walls there is a series of slides for receiving the drawing board. A right-angled totally-reflecting prism with the hypotenuse blackened, is placed over the upper end of the bellows. Rays of light originating from the light-source then pass horizontally through the Microscope, are reflected at the prism, and pass vertically downwards through the bellows on to the drawing board in the box. The source of light is generally an incandescent lamp. The author keeps the arrangement installed in the rear of his workroom, the front (closed) side being towards the window. In this way he finds that the image projected into the box is bright enough without further darkening of the room. By removing the prism, and by setting the bellows horizontally on a board with runners, the apparatus can be used for photomicrography.

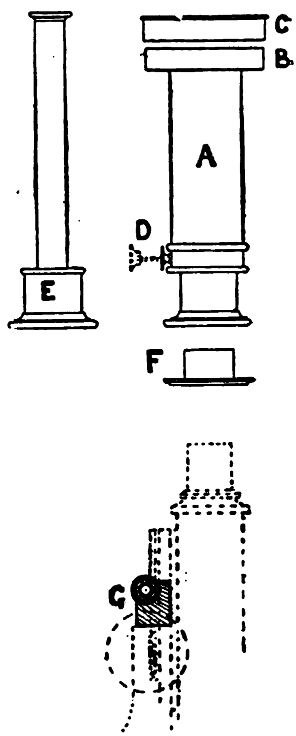

Fig. 152.

(4) Photomicrography.

J. W. Gordon's Apparatus for Photomicrography.†—In this application of photography to the Microscope, the instrument is used in a vertical position. The apparatus consists of a tube A, about 6 in. long, which is placed over the eye-piece. At the upper end of this tube B, a photographic plate, 1⅝ in. square, is held by means of a cap C, in a light-tight chamber; between this and the eye-piece is a projection lens focused upon the plate, and a small exposing shutter D is placed in the tube for making the exposure (fig. 152).

If the observer's eyesight be normal, the photograph will be sharp when the Microscope is in its ordinary focus, but, as almost everyone has slight errors of vision, it has been found desirable to supply a duplicate tube E, with a focusing eye-piece of high power, which is first placed on the instrument in order to focus, and is then replaced by the camera.

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 470–4 (3 figs.).
† R. and J. Beck's Special Catalogue, 1905, 4 figs.

A small flange F fitted over the eye end of the Microscope is required, to form a table upon which to rest the camera.

In order to overcome the tendency of the body to move downwards during a prolonged exposure, a block of metal G, which slides up and down the coarse adjustment, and can be clamped in any position, is supplied.

A yellow screen H (fig. 153), fixed on a stand with universal motion, should be employed between the Microscope mirror and the light in connection with isochromatic plates for all powers higher than a ⅔ in., otherwise the focus cannot be relied on with certainty.

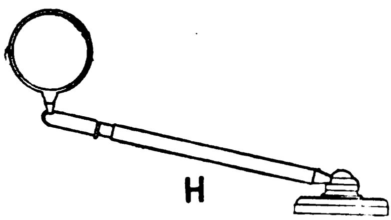

FIG. 153.

With this apparatus photographs can be made 1⅝ in. in diameter, having such fine detail that they will bear enlargement to any reasonable extent. One of the chief advantages of this extremely simple method of photomicrography is that the optical performance of the Microscope is exactly the same as when it is used for visual observation. The apparatus is made by the firm of R. and J. Beck.

A Perfectly Steady Stand for Photomicrography.*—J. Ries has sought to attain (1) the advantages of the Zeiss large photomicrographic camera by a less costly construction; and (2) to contrive an apparatus which shall be useful for all kinds of photography. The Zeiss model requires two tables, one for the Microscope and one for the camera, so that the unavoidable slight disturbances of the camera due to manipulation shall not extend to the Microscope. The cost and the dimensions of so much apparatus practically limit its use to institutions. The author seeks to make his Microscope perfectly steady and at the same time independent of the camera by mounting it securely on a heavy triangular base. This base fits freely but accurately within a triangular frame to which the optical bench with camera is attached. Thus the size of the whole is kept within moderate limits. The bellows are 45 cm. long, and are controlled by a double rod-rack gear. The front and back frames are secured on two platforms clamped to the optical bench and governed by the rod-gear. The camera can be easily set up or removed. It may be used without the Microscope, and thus serve for all photographic purposes. The author illustrates his method by suitable diagrams.

H., Dr.—**Unsichtbares Licht im Dienste der Mikroskopie.**
[Mainly deals with Dr. Köhler's photomicrography with ultra-violet rays.]
Central.-Zeit. f. Opt. u. Mech., xxvi. (1905) p. 34.

SIMON ET SPILLMANN, L.—**Application de la photographie à la numération des éléments figurés du sang.** *Comptes Rendus*, lvii. (1904) pp. 659–60.

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* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 475–8 (5 figs.).

(5) Microscopical Optics and Manipulation.

Czapski's Elements of the Theory of Optical Instruments.*— This work, whose nature is well expressed by its full title, has now reached its second edition, and contains 479 large octavo pages. It has become nearly double the size of the first edition, and, like its predecessor, forms a part of Winkelmann's "Handbook of Physics." The original nine sections are now extended to sixteen, and are so enlarged and revised that this second edition is practically a new work.

Sections VIIB, XIII, XIV, are by Dr. Eppenstein; VIIIA, IX, X, by Dr. von Rohr; and the others are by Dr. Czapski. The scope of the work will be inferred from the following list of the section titles:—

I (pp. 1–26). Geometrical optics.
II (pp. 27–64). Geometrical theory of the optical image.
IIIA (pp. 64–86). Realisation of the optical image by small pencils in the neighbourhood of the axis of centred spherical surfaces.
IIIB (pp. 86–100). Realisation of the optical image by oblique elementary pencils (astigmatic refraction).
IIIC (pp. 101–2). The image by astigmatic refraction or reflection on doubled curved surfaces.
IIID (p. 103). General theorems on homocentric refraction.
IV (pp. 104–163). Artificial enlargement of the image-limits (theory of spherical aberration).
V (pp. 164–183). Chromatic aberrations of dioptric systems (theory of achromatism).
VI (pp. 184–210). Prisms and prism-systems.
VII (pp. 211, etc.). Limiting of the rays and the properties of optical instruments dependent thereon.
VIIA (pp. 212–247). Diaphragms as a means for the selection of the rays essential for an optical image.
VIIB (pp. 248–260). Diaphragms as a means for the plane representation of a space.
VIIC (p. 260). Development of the theory of ray-limitation.
VIII (pp. 261–269). The eye.
VIIIA (pp. 270–295). Vision.
IX (pp. 295–320). The photographic objective.
X (pp. 320–328). Spectacles.
XI (pp. 328–335). The loup, or single Microscope.
XII (pp. 335–373). The compound Microscope.
XIII (pp. 373–4). Enlarged projection-systems.
XIV (pp. 375–385). Illumination-systems.
XV (pp. 386–432). The telescope.
XVI (pp. 432–471). Methods for the empirical determination of the constants of optical instruments.

The numerous figures are very clearly drawn, and to most of the sections bibliographies are appended.

* Grundzuge der Theorie der Optischen Instrumente nach Abbe, von Dr. Siegfried Czapski; unter Mitwurkung des Verfassers und mit Beiträgen, von M. von Rohr; herausgegeben von Dr. O. Eppenstein; mit 176 Abbildungen. Leipzig: Johann A. Barth, 1904.

Von Rohr's Image-formation in Optical Instruments from the Standpoint of Geometrical Optics.*—This work, whose full title is given below, forms the first volume of a treatise on the theory of optical instruments. It is dedicated to Professor Abbe, and the preface has been written by Dr. Czapski. It is divided into ten chapters, as follows, the names of the respective contributors being given in square brackets:—

I (pp. 1–35). The claims of geometrical optics. [H. Siedentopf.]
II (pp. 36–82). Calculation-formulæ. [A. König and M. von Rohr.]
III (pp. 83–123). Abbe's geometrical theory of the optical image. [E. Wandersleb.]
IV (pp. 124–207). Realisation of the optical image. [P. Culmann.]
V (pp. 208–338). Theory of spherical aberrations. [A. König and M. von Rohr.]
VI (pp. 339–372). Theory of chromatic aberrations. [A. König.]
VII (pp. 373–408). Calculation of optical systems on the basis of the theory of aberrations. [A. König.]
VIII (409–465). Prisms and prism-systems. [F. Löwe.]
IX (pp. 466–507). Ray limitation in optical systems. [M. von Rohr.]
X (pp. 508–547). The ray-path through optical systems. [M. von Rohr.]

Many of the chapters are followed by collections of historical and bibliographical notes.

Diffraction-Image and Absorption-Image.†—K. Strehl has found that S. Apáthy's attitude towards the diffraction theory of microscopic vision is not always understood, that he is even accused of "attacking the Abbe theory of microscopical image formation." He states that Apáthy does not dispute the Abbe theory, but that he only limits it. Apáthy is of opinion that the ordinary microscopic image may be, as it were, a superposition of three images, quite different in their nature, i.e. of a diffraction-image in Abbe's sense, of a refraction-image, and of an absorption-image. He ascribes the chief function to the last named image. K. Strehl endeavours to make the views of himself, Apáthy and Abbe clear on these points.

MICHAELIS, L.—**Ultramikroskopische Untersuchungen.**
Virchow's Arch. f. pathol. Anat., Bd. clxxix. (Folge 17, Bd. ix.) 1905, pp. 195–200.

WALKER, J.—**Analytical Theory of Light.** C. J. Clay (London, 1904) 432 pp.

(6) Miscellaneous.

Optical Properties of Glasses produced by Chance Brothers.‡—By the courtesy of Messrs. Chance Brothers and Co. we are enabled to give the following table of the optical properties of the glasses produced

* Die Bilderzeugung in Optischen Instrumenten vom Standpunkte der geometrischen Optik. Bearbeitet von den Wissenschaftlichen Mitarbeitern an der optischen Werkstätte, von Carl Zeiss, P. Culmann, S. Czapski, A. König, F. Löwe, M. von Rohr, H. Siedentopf, E. Wandersleb. Herausgegeben von M. von Rohr. Berlin: J. Springer (1904) 8vo, 587 pp., 133 figs. in text.
† Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 1–10.
‡ See also Catalogue Optical Convention, 1905, pp. 2–3.

Table of Optical Properties.

No.	Name.	n_D	ν	Medium Dispersion. C–F	C–D	$\frac{C-D}{C-F}$	D–F	$\frac{D-F}{C-F}$	F–G′	$\frac{F-G'}{C-F}$
					Partial and Relative Partial Dispersions.					
C 644	Extra hard crown	1·4959	64·4	0·00770	0·00228	0·296	0·00542	0·704	0·00431	0·560
B 646	Boro-silicate do.	1·5096	63·3	0·00803	0·00236	0·294	0·00562	0·700	0·00446	0·555
A 605	Hard do.	1·5175	60·5	0·00856	0·00252	0·294	0·00604	0·706	0·00484	0·554
C 577	Medium barium do.	1·5738	57·9	0·00990	0·00293	0·296	0·00697	0·704	0·00552	0·557
C 579	Densest barium do.	1·6065	57·9	0·01046	0·00308	0·294	0·00738	0·705	0·00589	0·563
A 569	Soft do.	1·5152	56·9	0·00906	0·00264	0·291	0·00642	0·708	0·00517	0·570
B 563	Medium barium do.	1·5660	56·3	0·01006	0·00297	0·295	0·00709	0·704	0·00576	0·572
B 535	Barium light flint	1·5452	53·5	0·01020	0·00298	0·292	0·00722	0·701	0·00582	0·570
A 490	Extra light do.	1·5316	49·0	0·01085	0·00313	0·288	0·00772	0·711	0·00630	0·580
A 485	Extra light do.	1·5333	48·5	0·01099	0·00322	0·293	0·00777	0·707	0·00640	0·582
C 474	Boro-silicate do.	1·5623	47·4	0·01187	0·00343	0·289	0·00844	0·711	0·00693	0·584
B 466	Barium light do.	1·5833	46·6	0·01251	0·00362	0·288	0·00889	0·711	0·00721	0·576
B 458	Soda do.	1·5482	45·8	0·01195	0·00343	0·287	0·00852	0·713	0·00690	0·577
A 458	Light do.	1·5472	45·8	0·01196	0·00348	0·291	0·00848	0·709	0·00707	0·591
A 432	Light do.	1·5610	43·2	0·01299	0·00372	0·287	0·00927	0·713	0·00770	0·593
A 410	Light do.	1·5760	41·0	0·01404	0·00402	0·286	0·01002	0·713	0·00840	0·598
B 407	Light do.	1·5787	40·7	0·01420	0·00404	0·284	0·01016	0·715	0·00840	0·591
A 370	Dense do.	1·6118	36·9	0·01657	0·00470	0·284	0·01187	0·716	0·01004	0·606
A 361	Dense do.	1·6214	36·1	0·01722	0·00491	0·285	0·01231	0·715	0·01046	0·608
A 360	Dense do.	1·6225	36·0	0·01729	0·00493	0·286	0·01236	0·715	0·01054	0·609
A 337	Extra dense do.	1·6469	33·7	0·01917	0·00541	0·285	0·01376	0·720	0·01170	0·655
A 299	Densest do.	1·7129	29·9	0·02384	0·00670	0·281	0·01714	0·789	0·01661	0·678

by their firm. The glasses are arranged in order of descending values of v. Those whose factory number is preceded by the letter A are the ordinary silicate crowns and flints which have been in use for over half a century. Those marked with the prefix B are of more modern introduction, while those preceded by C are of quite recent introduction.

The optical constants as given in the table are to be regarded as type values, which are adhered to with considerable accuracy from one melting to another. The spectrum lines used for the specification of these constants are the lines of the hydrogen spectrum known as C, F and G′, and the sodium line D to which latter the refractive index n_D refers. The wave-lengths of these lines may be taken in micromillimetres as follows :—

$$C = 0 \cdot 6563 \qquad D = 0 \cdot 5893$$
$$F = 0 \cdot 4862 \qquad G' = 0 \cdot 4341$$

The difference between the refractive indices for the C and F lines, generally called the interval C − F, is defined as the mean dispersion, while the partial dispersions and their relative values, obtained by dividing the partial dispersion by the mean dispersion, are also specified. The value of v is given by

$$v = n_D - \frac{1}{C - F}.$$

Chance Brothers' Cover Glasses of thin Glass for Microscopic Preparations.*—This thin glass is made in three thicknesses, and in all usual sizes both square and round ; larger pieces for special purposes are also supplied. This glass is chemically of the "hard crown" type, but differs in its mode of manufacture. Its optical constants, which have been measured by means of specially prepared prisms, are as follows :—

n_D	v	Medium Dispersion. C−F	Partial Dispersions.		
			,	D−F	F−G′
1·5158	57·4	0·00898	0·00294	0·00604	0·00511

Manipulation of the Microscope.†—This most excellent manual, the work of Edward Bausch, was originally published twenty years ago, since when it has deservedly run through four editions. In simple language are described the stand, its various parts and accessories, how to manipulate these in the proper way and with the best effect, the volume ending with instructions as to the care of a Microscope. The index is quite complete.

Elementary Microscopy.‡—This handbook on Elementary Microscopy is the outcome of a series of articles on "Microscopy for Beginners," by F. Shillington Scales. The material has been re-cast

* Catalogue, Optical Convention, 1905, p. 4.

† Bausch and Lomb Optical Co., Rochester, N.Y., 4th ed., 1901, 202 pp., with numerous illustrations.

‡ London: Baillière, Tindal and Cox, 1905, xii. and 179 pp., 77 figs.

and practically re-written. The work deals with the simple and compound Microscope, the choice of a Microscope, objectives and eye-pieces, accessory apparatus, the practical optics of the Microscope, the manipulation of the Microscope and its accessories. The volume may be heartily recommended as a useful guide to beginners.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Formate Broth in the Differential Diagnosis of Micro-organisms.† —W. Omelianski refers to the differentiating properties of media containing alkaline salts of formic acid in the diagnosis of micro-organisms. Whereas most pathogenic forms behave negatively or passively, the nearly allied non-pathogenic bacilli split up the formate, with the development of gas, CO_2 and H, and the formation of carbonates. If phenolphthalein has been added to the medium, the increased alkinity will be shown by the appearance of a red coloration; but this reddening of the medium occurs not only from the splitting up of formates, but also by the decomposition of albuminous substances in the medium. Cultures of *B. coli* and *B. typhi* grown on this medium (formate agar bouillon) both produce a red coloration, which in the case of *B. coli* is more intense and appears earlier. The weaker and later appearing redness of the culture of *B. typhi* is not because this organism decomposes the formate more slowly, since it has no action on these salts, but is due entirely to the formation of alkaline decomposition products of albuminous substances; in the same manner is explained the reddening of the medium with cultures of *B. fæcalis alcigenes* and *B. dysenteriæ* Flexner. The author has contrived to set aside this objection by estimating the amount of gas produced by the cultures, using for this purpose an arrangement of Einhorm's saccharometer. The medium he uses is ordinary pepton broth, with the addition of 0·5 p.c. of sodium formate.

With six different strains of *B. typhi abdominalis*, and by making all possible variations—both as to the strength of the formate present and the age of the culture used—he was in no instance able to show the slightest evidence of any decomposition of the formate. All cultures of *B. coli communis* showed energetic destruction of the formate with an abundant production of gas; with cultures of paratyphoid A and B the decomposition of the salt and production of gas were equally energetic; five different strains of *B. dysenteriæ* behaved like those of *B. typhi*, producing not the slightest decomposition of the formic salt.

Identification of Colonies of Pneumococcus.‡—L. Buerger prepares the following media: neutral agar made from meat juice, and containing 1·5–2 p.c. of pepton, and 2·5 p.c. of agar, is melted down, and,

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Centralbl. Bakt., 2te Abt., xiv. (1905) p. 673.

‡ Centralbl. Bakt., 1te Abt., xxxix. (1905) p. 20.

when cooled sufficiently below the coagulating point of the serum to be employed, one-third of its volume of sterile ascitic fluid is added, mixed and poured into tubes; glucose serum agar is made in the same way, 0·5–2 p.c. of glucose agar being used. He finds that on these media, after 18–24 hours, the surface colonies of pneumococcus appear as flat circular disks, which when viewed from above show slightly depressed centres, whereas side on and by transmitted light they appear as milky rings enclosing a transparent centre, a "ring type," of various sizes. In older colonies, 72 hours, the central opacity increases and the ring is less marked. The author considers that this type of colony is diagnostic of pneumococcus, and must be distinguished from the ring forms occasionally seen with streptococcus, but which possess a distinct nucleus, and from those colonies that only show rings by transmitted light, but which by reflected light show a definitely raised centre.

Apparatus for Dissolving and Filtering large Quantities of Gelatin and Agar, etc.*—C. Blecher describes the following apparatus. It consists of four parts: (1) The heating kettle of enamelled iron to receive the solution from the suction vessel. It has a tight-fitting lid provided with two perforations, one for a thermometer, the other for the suction tube connected with an air pump. (2) The solution vessel. (3) The suction vessel, which in size and shape is like the solution vessel, excepting that near the rim it is provided with a tube in which is fixed a glass tube bent at right angles and carried up parallel to the wall of the vessel and through the perforation in the lid. (4) The filter, also of enamelled iron, with a perforated bottom that fits by means of a rubber hoop to the rim of the suction vessel. In using the apparatus the solution vessel containing the substance to be dissolved and the solvent is placed in the kettle, which is filled 10 cm. high with water, heated to boiling-point and kept at that temperature until the solution has attained the desired temperature; the kettle is then closed, and when solution is complete the solution vessel is taken out. The suction vessel, with the filter attached, is then placed in the kettle, the bottom of the filter being fitted with a moistened layer of washing flannel or filter-paper; the fluid from the solution vessel is now poured into the filter vessel, the suction pipe is passed through the opening in the lid; this is closed, and the pipe is joined with the pump; whilst the suction is taking place the temperature is kept constant by gentle heating. When filtering is completed, the gelatin, etc., is found to be quite clear in the suction vessel.

Methods for Determining the Immunity Unit for Standardising Diphtheria Antitoxin.†—M. J. Rosenau gives details of the methods used in the determination of the standard of immunity. After briefly discussing Ehrlich's "side-chain" theory of immunity, he finds that from a theoretical point of view, the unit of immunity, in the case of diphtheria, may be defined as that quantity of diphtheria antitoxic serum which will just neutralise 200 minimal lethal doses of a pure poison, that is a poison which contains only toxin, and no toxoid, toxone, or other substances capable of uniting with the antibodies. The minimal lethal dose is defined as that quantity of toxin which will surely kill

* Centralbl. Bakt., 2te Abt., xiv. (1905) p. 415 (1 fig.).
† Hyg. Lab. Bull. No. 21 (1905) Washington, U.S.A.

every guinea-pig weighing 250 grm. in the course of 4 days, or at the very latest, 5 days.

For the preparation of the toxin he uses a culture of "Park's bacillus No. 8" grown as a surface growth in a special bouillon; the strongest poisons being obtained when the surface growth is heavy and the broth remains clear. The medium known as "Smith's bouillon" is prepared as follows: the meat is ground in the usual way, the expressed juice being collected, weighed and added to twice its weight of water, placed in the cool for 24 hours, strained, and again weighed; it is then neutralised with sodium hydrate to 1·5 p.c. acidity to phenolphthalein; it is now inoculated with *B. coli communis*, by adding 10 c.cm. of a 24-hour old broth culture for each litre of the meat infusion; this is grown at 37° C. for 24 hours; add the white of one egg for each litre of the infusion, heat for 20 minutes to coagulate the albumen, and filter while hot through paper; weigh the filtrate obtained, and add water to make up the loss; neutralise with sodium nitrate to an acidity of 0·5 p.c., add 1 p.c. pepton, ½ p.c. sodium chloride, and 0·1 p.c. dextrose; heat again for 20 minutes in streaming steam in an open autoclave; again neutralise to 0·5 p.c., filter through paper and fill into Fernbach flasks, then sterilise in the autoclave at 120° C. for 20 minutes. The flasks are then inoculated on the surface from a 24-hour old culture, and incubated for 7 days at 37·5° C. The bouillon is then passed through a porcelain filter by means of a vacuum, and stored in flasks provided with a syphon and Maasen nozzle for the convenience of drawing off small amounts from time to time. The toxicity of the poison is then determined by inoculating guinea-pigs. The writer describes the usual method of preparing antitoxic serum, and indicates the precautions to be taken in order to keep the serum dry and free from the oxidising action of the air, by the influence of phosphoric anhydride, and by storing it in a special ice-box at 5° C., and so guarding it against the action of light and maintaining it at a constant low temperature. For determining the antitoxic value of this serum, a glycerinated solution is made by weighing 1 grm. of dry serum and dissolving it in 1 part physiological salt solution (0·85) and two parts glycerin. From this solution, by means of specially made pipettes, varying dilutions with physiological salt solution are obtained. Exact amounts of the dilutions of toxin and of serum are now filled into specially prepared syringes, where they are actively shaken to obtain an intimate mixture and are placed at room temperature in diffused light one hour before inoculation into the guinea-pigs. The animals always receive a total of 4 c.cm. of fluid, injected subcutaneously in the median abdominal line. As the limit of the minimal lethal dose or the mixture containing the L + dose of the toxin and one immunity unit is approached, one of three results occurs: (*a*) the animal dies from acute poisoning on about the fourth day; (*b*) it develops post-diphtheric paralysis between the fourteenth and thirtieth day; (*c*) it recovers.

Method for Growing Anaerobic Organisms under Aerobic Conditions.*—G. Tarozzi has devised a medium on which he has succeeded

* Centralbl. Bakt., 1te Abt. xxxviii. (1905) p. 619.

in growing, under aerobic conditions, certain strictly anaerobic saprophytes obtained from the intestinal contents of dogs and from putrefying human bodies, and which from their morphological relationship with the Tetanus bacillus he denotes as the group of Pseudo-tetanus bacilli; he also obtained good results with *B. tetani* and with the bacillus of symptomatic anthrax. The medium is prepared as follows:—A mouse, guinea-pig or rabbit is killed, opened aseptically, and with sterile forceps and scissors, pieces of liver, spleen, kidney, etc., are cut out, and placed in an equal number of tubes of broth and agar; these are incubated at 37° C. for two days and the contaminated tubes are discarded. He found that if a piece of fresh tissue was placed in a tube of broth, and after a few hours was taken out again, and the tube then inoculated with an anaerobic germ, the conditions were as favourable for its growth as if the portion of tissue were still present in the medium.

Difference of Behaviour of Bacillus typhosus and B. coli communis in Media containing Sulphate of Copper and Red Prussiate of Potash.*—A. Marrassini and R. Schiff-Giorgini find that nutrient broth, or broth and glycerin to which is added copper sulphate in proportions varying from $\frac{1}{5000}$ to $\frac{1}{1000}$, is quite decolorised by *B. coli communis*, and the medium rendered turbid, while when *B. typhosus* is sown therein no change takes place. An analogous reaction is observed when ferricyanide of potash, in the proportion of 2–5 p.c., is added to the medium. Here, after incubation at 37° C. for 48 hours, the medium inoculated with typhoid retains its greenish-yellow hue, while that in which *B. coli communis* has been sown has turned green, the colour becoming intensified as time goes on. The colour is due to the formation of a blue precipitate, and the precipitate to the production of lactic acid by the *Coli* organisms.

(2) Preparing Objects.

Fixing and Staining Nuclei.†—In his researches on the testing nucleus and mitosis, K. v. Tellyesniczky makes special reference to the effect of fixatives. As good fixatives are distinguished Flemming's strong solution and a mixture of 100 c.cm. 3 p.c. potassium bichromate and 5 c.cm. acetic acid. The sections were mordanted for 24 hours in saturated solution of copper acetate, then washed and stained in 1 p.c. hæmatoxylin solution for 24 hours, and finally differentiated in Weigert's decoloriser.

Fixation and Staining Muscle Fibres.‡—G. Schlater fixed embryos of the fowl in Hertwig's fluid, which consists of chromic acid (1 p.c.) 150 c.cm.; saturated solution of sublimate, 150 c.cm.; glacial acetic acid, 15 c.cm.; formalin (40 p.c.) 50 c.cm.; distilled water, 135 c.cm. Paraffin sections of the material were stained with Heidenhain's iron-hæmatoxylin.

Demonstrating Blood Formation in Osseous Fishes.§—H. Marcus fixed the eggs of *Gobius capito* in Carnoy's fluid (6 parts alcohol, 3 parts chloroform, and 1 part acetic acid) for 2–3 hours. After about an

* Atti Soc. Toscana Sci. Nat., xiv. (1905) pp. 174–7.
† Archiv Mikrosk. Anat. u. Entwickl., lxvi. (1905) pp. 367–483 (5 pls.).
‡ Tom. cit., pp. 440–68 (3 pls.). § Tom. cit., pp. 333–54 (1 pl.).

hour's immersion the capsule was removed with forceps or needles. From this fluid the eggs were removed to chloroform, and thence through chloroform-paraffin to paraffin m.p. 40°. This process is rather slow, but it avoids the overheating, which is so detrimental to the yolk. Formalin was found to fix the embryo badly. Tellyesniczky's fluid gave good results. After a fixation of 24 hours the material was washed, then stained with borax-carmin, and afterwards imbedded by the chloroform method in paraffin m.p. 40°. The sections were fixed to the slide with clove-oil-collodion.

(3) Cutting, including Imbedding and Microtomes.

Leitz' New Microtome.*—This instrument is described by Professor Henneberg who, after several months' use, has found it very satisfactory

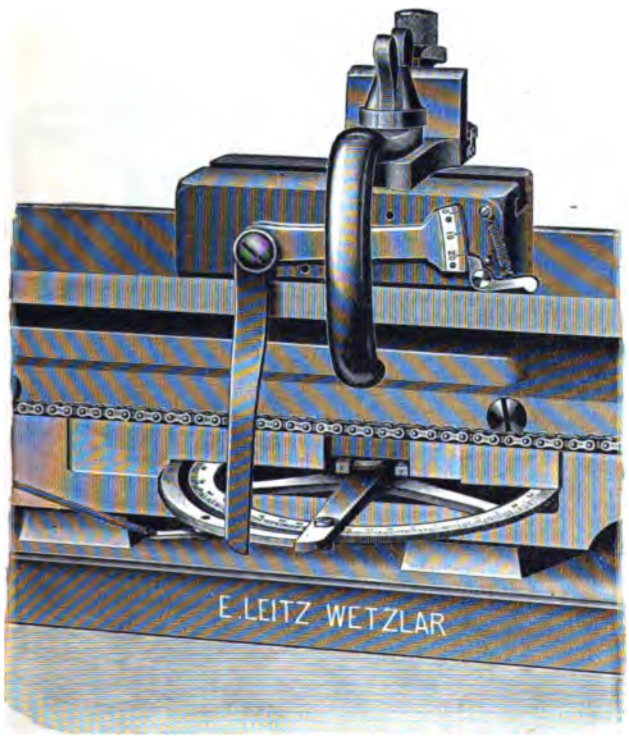

FIG. 154.

and adapted to its purpose. The instrument is a firmly-built sliding microtome, with automatic object-movement and large, heavy knife-slide, which can be worked direct by the hand or by chain and tooth-wheel. It is made in two sizes, with track-lengths of 32 and 42 cm.

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 125–30 (4 figs.).

respectively. For most purposes the small size suffices. When hand-motion is desired, a bent pin is fastened to the block (fig. 154) by means of the same screw which holds the knife-clamp. For chain-use the microtome is provided at each end with a beam-like projection, each of which carries a chain-wheel, one for the winch, the other for the straining of the chain. The winch can be fitted as shown in fig. 155, or at the other end, and thus an operator can rotate the winch either with his left hand or his right. Fig. 154 shows the manner of the automatic elevation of the object. The rotation of the tooth-wheel occurs indirectly through a bent curved movable lever screwed to the block (hence the "block-angle"). The lower end of the lever in the movement of the slide to the end of the track engages with a spring-hook, which itself engages in the teeth of the wheel and moves it on

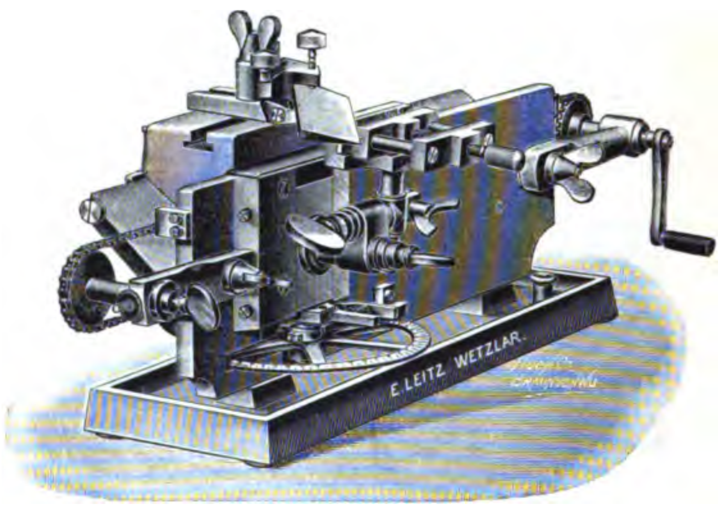

FIG. 155.

one notch. The length of the stroke, about which the block-angle rotates the wheel in this way, is dependent on the downward lever-end. The length is longer or shorter, as the block-angle is steeper or more oblique. The block-angle is arranged by the help of a small clutch which is set to the small scale at the lever-end, the numeration corresponding to the number of the wheel-teeth rotated at that particular position of the block-angle. A wheel-tooth corresponds to a section thickness of 0·001 mm. In its steepest position the block-angle corresponds to a wheel-rotation of 25 teeth, and the section thickness is then 25 μ. The forward movement of the clutch results from the action of the spiral spring visible in fig. 154, the clutch sliding over the teeth until a resistance is met with on the vertical wall of the microtome. In order that the tooth-wheel should not move too easily, a small brake (not shown in figure) is applied and regulated by a screw. For facilitating the adjustment of the object-holder the female-screw

fastened to it, and in which the tooth-wheel spindle moves, is formed of two halves, on each of which, as in a forceps, a limit is affixed. A spring applied between these presses both parts sufficiently tight

FIG. 156.

together. A pressure on the limb suffices to open the screw, and the object-holder can then be pushed up and down.

By the use of two screws in the knife-holder it is possible to set the

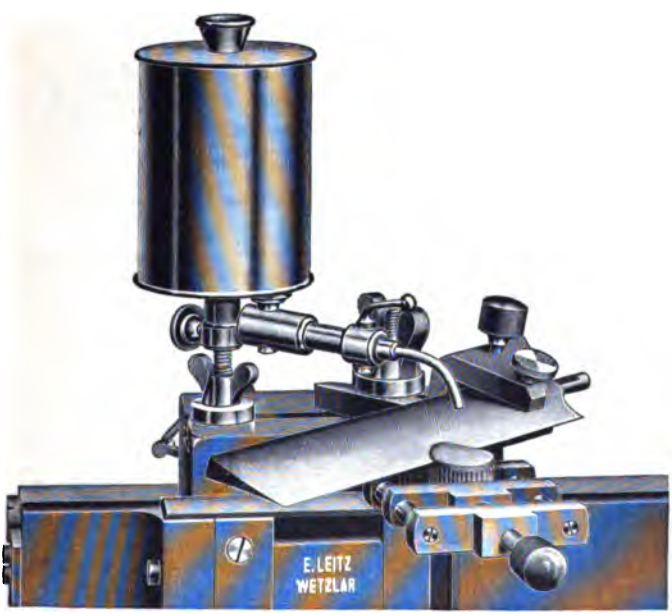

FIG. 157.

knife flat or oblique; moreover, the knife moves on a slab rotatory about an axis (figs. 155 and 156). The screw for clamping the knife-rest moves on a block in a groove, whereby the adjustment of the clamp

is very conveniently performed. A dropping apparatus is added for moistening the knife with 70 p.c. alcohol in the cutting of celloidin sections. The alcohol reservoir is rotatory about the supporting axis, and the outflow tube is set excentrically for the adjustment of the delivery. This dropping apparatus is secured to the knife-block, and moves with it (fig. 157).

Arndt's Double Saw.*—The introduction of this auxiliary, which was noticed in this Journal† a few years ago, has been found so useful that the inventor has brought out an improved form. It is intended for preparing microscopic sections from hard objects. The working space of the saw has now been increased to 6·5 cm., and there are also other improvements.

(4) Staining and Injecting.

Differential Stain for Gonococcus.‡—R. Leszczynski employs the following method: cover slip preparations are made from the pus diluted with water in the usual way, and after fixing in the flame are treated for 60 seconds with thionin solution (sol. sat. aq. thionin 10 c.cm.; aq. dest. 88 c.cm.; acid carbol. liquef. 2 c.cm.) and washed in water. Then treat for 60 seconds in picric acid solution (sol. sat. aq. acid picric; sol. aq. caustic potash 1 : 1000; āā 50 c.cm.). Without washing in water, treat for 5 seconds with absolute alcohol; wash in water, dry, and mount in balsam.

The protoplasm of the pus cells is stained straw-yellow and the nuclei red-violet, the gonococci appearing as black sharply contoured diplococci, the other bacteria are yellowish-red to pinkish-red. The extra-cellular cocci and those lying deeply in the protoplasm of the cells are often not stained in a characteristic manner.

Persio-acetic Acid as a Stain for Vegetable Tissue.§—G. Beck von Managetta recommends a new pigment, Persio, for staining vegetable tissue. It is a red indigo, and is much like Orseille in origin and composition. It is a purple powder, easily soluble in water and acetic acid, and little or not at all in alcohol. As persio-acetic acid it is extremely valuable, a strong solution staining deeply in 1–2 minutes. The stained sections may be mounted in glycerin, potassium acetate, and venetian turpentine, by all of which the tone is advantageously altered. Persio-acetic acid will combine with other pigments. The author mentions combinations with nuclear black, nigrosin, methyl-green, and gentian-violet.

New Method of Rapid Staining Nervous Tissue with Gold Chloride.‖—B. de Nabias fixes the tissue in any solution which allows after-treatment with iodine. The sections on the slide are dehydrated, and then immersed in Gram's iodine solution until they become yellow. After washing in distilled water they are placed in 1 p.c. gold chloride

* Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 104–18 (5 figs.).
† J.R.M.S. 1902, p. 112.
‡ Centralbl. Bakt. Ref., 1te Abt., xxxvi. (1905) p. 692.
§ SB. Deutsch. Naturwiss. Vereins f. Böhmen, "Lotos," 1904, No. 7. See also Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 166–8.
‖ C. R. Soc. Biol., lvi. (1904) p. 426.

solution. They are again washed, and then treated with 1 p.c. anilin water. After washing again in distilled water the sections are passed through graded alcohols to xylol and balsam.

Method of Contrast Staining with Bleu de Lyon and Picric Acid.§—Skrobansky takes the sections which have been previously stained with borax-carmin from distilled water and places them in the following mixture:—Distilled water 50 parts; saturated alcoholic solution of bleu de Lyon 2 parts; saturated aqueous solution of picric acid 5 parts. In this the sections remain for 2–3 minutes, and are then passed through graded alcohols to xylol and mounted in balsam.

Staining Tubercle Bacillus.‖—A. Mendoza, in some further observations on this subject, remarks that other mixtures produce a perfect staining. Thus iodine-green, when the water is saturated with oil of turpentine, stains the bacilli beautifully, though the strength of the decoloriser must be reduced. Some pigments will give a double stain, e.g. methylen-blue, when used in conjunction with thymol (saturated aqueous solution of thymol 80 c.cm.; saturated alcoholic solution of methylen-blue 10 c.cm.; alcohol 10 c.cm.). The bacilli stain dark blue and the rest of the elements a red-violet, though to obtain this result the strength of the decoloriser must be reduced to one-fifth (20–80 of water).

New Method of Capsule Staining.¶—L. Buerger's method requires the following solutions:—(1) Blood serum, diluted with equal bulk of normal saline or ascitic or pleural fluid; (2) Müller's fluid, saturated with sublimate; (3) 80–95 p.c. alcohol; (4) tincture of iodine (7 p.c.); (5) fresh anilin water, gentian-violet solution, or fuchsin solution; (6) 2 p.c. aqueous salt solution. A film is made by mixing some culture with a drop of serum on a cover-glass. When it is about half dry the film is covered with fixative. It is then gently warmed, and after a quick wash in water is passed through alcohol, and then treated with the iodine solution for about a minute. The cover-glass is then washed with alcohol until no more iodine comes off. After drying in the air, the film is stained for three seconds; it is then washed and mounted in salt solution. The preparation may be ringed round with vaselin before examination.

If the films be stained with fuchsin, they should be examined in water. Gram's method may be adopted, and the preparations after-stained with 10–15 p.c. aqueous fuchsin. Mounting in balsam destroys the sharp outline of the capsule, though the preparations are fairly good.

Demonstrating Fat in the Animal Liver.*—C. Deflandre, when investigating the adipogenic function of the liver† had recourse to the following histo-chemical methods. The freshly removed liver was cut up into thin slices and immersed in strong Flemming [chromic acid (10 p.c.) 15 parts; osmic acid (1 p.c.) 80 parts; glacial acetic acid 10 parts; distilled water 95 parts] for 24 hours. The pieces are then

* Intern. Monatsschr. Anat. u. Phys., xxi. (1904) pp. 21–2. See also Zeitschr. wiss. Mikrosk., xxii. (1905) p. 138.
† Bol. Inst. Alfonso XIII., i. (1905) pp. 61–2. See *ante*, p. 529.
‡ Centralbl. Bakt., 1te Abt. Orig., xxxix. (1905) pp. 216–24, 335–52 (9 figs.).
§ Journ. Anat. et Physiol.. xl. (1904) pp. 79–80.
‖ J.R.M.S. 1904, p. 301.

washed in running water for 24 hours. For washing, a funnel with a siphon stem was used. This, when placed under a tap, kept filling and emptying automatically. A large number of pieces, if properly labelled, can be washed by this method at the same time.

The pieces were next dehydrated in absolute alcohol, cleared up in xylol, and imbedded in paraffin. Impregnation with paraffin should be done as quickly as possible, as protracted immersion in xylol tends to dissolve out the fat droplets. The sections may be mounted unstained in glycerin or stained for 24 hours in safranin. The safranin was a strong alcoholic solution mixed with anilin water. Magenta red and picric acid were also used, but the effect was less delicate.

Staining Nerve Endings in Skin of Mammals.*—A. S. Dogiel used a 1–2 p.c. solution of silver nitrate wherein were placed small pieces of skin, the solution being incubated at from 34°–36° C. for 3–5 days. The pieces were quickly washed in distilled water and then transferred to the reducing solution of formalin and pyrogallic acid for 3–5 days. If the silver had been reduced the preparations were washed in distilled water, then hardened in absolute alcohol, and, after imbedding in celloidin, were sectioned.

Examination of Cultures and Smears from Throat and Nose.†—W. T. G. Pugh recommends the following procedure for detecting the presence of diphtheria bacilli in exudations of the throat and nose. The stain consists of toluidin blue 1 grm. dissolved in 20 c.cm. absolute alcohol and 1 litre of distilled water, to which 50 c.cm. of glacial-acetic acid are added. The films and smears should be stained for two minutes or longer. When examined by artificial light the Babes-Ernst granules, whether in bacilli or cocci, are seen to be stained reddish-purple, the diphtheria bacilli thus standing out prominently.

Staining Nerve Fibrils.‡—According to A. Bethe the staining of nerve fibrils is due to the presence of an acid, "fibril acid," which is insoluble in ether. He gives three methods. (1) The old ether method, which is uncertain as to its results. The piece of fresh tissue is placed in ether, which is frequently changed. After two days it is transferred to a solution of toluidin blue, 1 : 3000, and on the following day to ammonium molybdate. It is then imbedded and sectioned. (2) New ether method. The fresh tissue is first treated with ether, and afterwards dehydrated with absolute ether. It is then transferred to xylol and afterwards imbedded. (3) Ammonia method. Fix with alcohol, to 7–10 parts of which 1 part of ammonia is added; imbed and stain as before.

Use of Electrolysis for the Metallic Impregnation and Staining of Tissues.§—L. Sanzo places the two electrodes of a battery in a basin filled with distilled water. To the negative pole is fixed a piece of tissue previously impregnated with nitrate of silver. A weak current is then passed and this decomposes the silver nitrate, the acid radicle going to

* Anat. Anzeig., xxvii. (1905) pp. 97–118 (10 figs.).
† Lancet, 1905, ii. pp. 80–1.
‡ Zeitschr. wiss. Mikrosk., xxi. (1904) pp. 344–8.
§ Anat. Anzeig., xxvii. (1905) pp. 269–70.

the positive pole while the silver remains at the negative, being free to combine with the tissue elements.

By fixing unimpregnated tissue to the positive pole an acid reaction is obtained, and this makes the tissue more receptive of the silver salt. In a similar way by placing pieces of tissue on the anode or cathode the tissues may be rendered acid or basic, so as to mordant them as it were for basic or acid stains.

(6) Miscellaneous.

Microtomists' Vade Mecum.*—The new edition of the Microtomists' Vade Mecum, a handbook of the methods of Microscopic Anatomy, by A. Bolles Lee, contains much new matter, room for which has been found by condensation and rearrangement. Some chapters, e.g. on connective tissues and on blood and glands, have been practically re-written, and those on the nervous system have been elaborated and much new and important matter added. The Microtomists' Vade Mecum is so well known and so universally consulted by every class of histologist that it is unnecessary to launch out into praises of its many merits, and it only remains to congratulate the author on his energy in bringing his invaluable work up to date.

BALL, M. V.—**Essentials of Bacteriology.** London: Kimpton, 1904, 4th ed.

KLOPSTOCK, M., u. KOWARSKY, A.—**Praktikum der klinischen, chemisch-mikroskopischen und bakteriologischen Untersuchungsmethoder.**
Wien: Urban u. Schwarzenberg, 1904, 296 pp.

LINDNER, P.—**Mikroskopische Betriebskontrolle in den Gärungsgewerben mit einer Einführung in die technische Biologie, Hefenreinkultur und Infektionslehre.**
Berlin: Paul Parey, 1905, 4th ed. enlarged, 521 pp., 237 figs., 4 pls.

LYNCH, R.—**Mikroskopische Untersuchung der Fäces. Ihre Bedeutung und ihre Anwendung in der ärtzlichen Praxis.** Leipzig: G. Thieme, 1904, 35 pp.

MIETHE, V.—**Traité pratique de recherches bactériologiques.**
Paris: Malonie, 1904.

STÖHR, PH.—**Lehrbuch der Histologie und der mikroskopischen Anatomie des Menschen mit Einschluss der mikroskopischen Technik.**
Jena: G. Fischer, 1905, 456 pp., 352 figs.

WINSLOW, CH.-E. A.—**Elements of Applied Microscopy. A Text-book for Beginners.**
New York: John Wiley and Sons, 1905, 183 pp.

Metallography, etc.

Thermal and Electrical Effects in Soft Iron.†—E. H. Hall, Churchill, Campbell and Serviss have made delicate measurements of the Thomson effect. Two bars of iron (99·93 p.c. Fe) were employed, one end of each bar being inserted in a mixture of ice and water, the other end in boiling water. An electric current (25 amperes) was passed through the bars, from cold to hot in one bar, from hot to cold in the other. The direction of the current could be reversed. The

* London: J. and A. Churchill, 6th ed., 1905, x. and 538 pp.
† Proc. Amer. Acad. Arts and Sci., xli. (1905) pp. 23–55.

differences of temperature (due to the difference in direction of the main current) between corresponding points in the two bars, were measured by means of thermo-electric couples of copper and German-silver, connected to a sensitive galvanometer. Similar measurements were taken with the main current reversed. Numerous details of the method and the precautions adopted are given by the authors. The following values were obtained for the Thomson effect coefficient ν,

$$\text{approximately}\begin{cases} -757 \times 10^{-10} \text{ mean, from } 13^\circ \text{ to } 90^\circ \\ -715 \quad ,, \quad ,, \quad ,, \quad 13^\circ \;,,\; 51^\circ \\ -793 \quad ,, \quad ,, \quad ,, \quad 51^\circ \;,,\; 90^\circ \end{cases}$$

Influence of Nitrogen on Iron and Steel.*—H. Braune points out that the abnormal brittleness frequently met with in iron and steel, especially in basic products, cannot be ascribed to the presence of large percentages of phosphorus, sulphur, or other elements, the effect of which is well known. As the result of six years work, the author states that this brittleness is caused by the presence of nitrogen absorbed by the metal in the processes of manufacture. The nitrogen exists as nitride of iron in solid solution in ferrite. To determine the effect of nitrogen on the quality of the metal, the author heated bars of high-grade iron and steel in ammonia gas at 800° C. for varying periods. Different proportions of nitrogen were absorbed; the bars were then annealed to bring about a regular diffusion of nitrogen through the metal. Curves are given showing the effect of increasing proportions of nitrogen on the mechanical properties of (1) soft iron containing 0·06 p.c. carbon, (2) steel containing 1·15 p.c. carbon. The effect is wholly injurious: 0·08 p.c., or more, nitrogen renders soft iron brittle; in the case of the high carbon steel the same effect results with only 0·03 p.c. nitrogen. Photomicrographs are given showing the remarkable changes in structure brought about by increasing percentages of nitrogen.

In an editorial note appended to the above article, H. le Chatelier † cites a number of facts—such as the well known difference in properties between acid and basic steel of the same composition—as to hitherto unexplained departures from established laws governing the relation between physical properties, chemical composition, and thermal treatment of steel. These irregularities have been attributed to the presence of elements, such as hydrogen and oxygen, which are difficult to estimate. H. Braune's researches suggest that the explanation may be sought in the presence of nitrogen. H. le Chatelier gives some results he has obtained in endeavouring to establish a relation between brittleness of metals and their microstructure. He suggests that nitrogen, when present in moderate proportions, may have the effect of facilitating the development of brittleness under unsuitable thermal treatment, rather than that of rendering the metal hopelessly bad.

The method of estimating nitrogen in iron, together with further details, is given elsewhere by H. Braune.‡

* Rev. Metallurgie, ii. (1905) pp. 497–502 (7 figs.).
† Tom. cit., pp. 503–7 (3 figs.).
‡ Op. cit., Extraits, ii. (1905) pp. 361–4 (4 figs.). See also Braune, H., "Sur le rôle de l'azote dans les fers et aciers." Bâle. Éditeurs, Walz et Mieville, 1905.

Brittleness of Cemented Mild Steels.*—To determine the cause of the brittleness resulting from the cementation of mild steel, J. Lecarme worked on steels of the following composition :—

	1.	2.
Carbon	0·100 p.c.	0·090 p.c.
Manganese	0·300 „	0·623 „
Phosphorus	0·031 „	0·065 „
Silicon	0·750 „	0·152 „

Four groups, each made up of ten pieces of each steel, were packed (*a*) in neutral matter, (*b*), (*c*), and (*d*) in carburising material of different degrees of activity, and heated at 1000° C., the different pieces in each group being maintained at this temperature for varying periods. The object of this series of experiments was to determine whether the brittleness is due to heating at a high temperature, or is influenced by the composition of the carburising material. After treatment the pieces were submitted to mechanical tests and microscopically examined. The changes in microstructure are shown by photomicrographs. The author concludes that the thermal treatment necessarily accompanying cementation does not induce brittleness, this fragility being caused by some chemical change in the soft core taking place simultaneously with the superficial cementation. Widely differing degrees of brittleness result when steels obtained from different sources, though of similar chemical composition, are submitted to the same treatment. It is usually possible by suitable treatment to remove the brittleness resulting from cementation.

H. le Chatelier † puts forward some criticisms of J. Lecarme's inferences, and remarks that the chief object of their publication is to induce other workers to investigate the subject more fully. The presence of nitrogen may influence the results.

Technique of Microscopic Metallography.‡—H. le Chatelier describes the improvements in the details of polishing, etching, etc., effected in his laboratory since the publication of his former article on the same subject.§

Grinding.—A rapidly revolving emery wheel, against which the section is lightly pressed, gives the best results. For quenched steels which surface-heating might let down, a wheel flooded with water and revolving at slower speeds should be used. It has been stated that if the section does not become too hot to hold with the fingers, the temperature cannot rise sufficiently to have any effect on the metal. This is not the case, as the surface pressed against the emery wheel may be considerably hotter than the mass of the piece. To remove the modified skin which appears to be the unavoidable result of grinding on emery wheels, the section should be rubbed by hand on moderately coarse emery paper. Moistening emery paper with oil of turpentine

* Rev. Metallurgie, ii. (1905) pp. 516–25 (6 figs.).
† Tom. cit., pp. 526–7.
‡ Rev. Metallurgie, ii. (1905) pp. 528–37 (3 figs.)
§ Bull. Soc. d'Enc.; see also "Contribution à l'étude des alliages," pp. 421–40, and Metallographist, iv. (1901) pp. 1–22.

hastens the operation. The edges of the section should be bevelled to avoid tearing the polishing papers and cloths.

Fine Polishing.—The author insists on the importance of using powders of uniform dimension of grain. The time spent in their preparation is fully repaid by the increased rapidity of polishing. For iron and steel three powders are used, sieved emery, levigated emery (finer), and washed alumina. The author's methods for the preparation of these are given in detail. Fine flannel maintained in a state of tension on glass is used as supporting medium for the polishing powders. Filtered soap solution serves to fix the powder to the cloth. Surfaces thus prepared may be used for polishing dry or damp. To shorten the time occupied in polishing, revolving wooden discs, covered with fine cloth, or felt discs, may be used in the final stage when alumina is employed.

Methods of Etching.—A 5 p.c. solution of picric acid in alcohol has come into general use. Two reagents recommended by Kourbatoff are: (1) amyl alcohol containing 4 p.c. nitric acid; (2) 4 p.c. solution of nitric acid in ordinary alcohol 1 part, saturated solution of nitrophenol in ordinary alcohol 3 parts. Cementite is readily coloured, other constituents not being affected, by a solution containing 25 p.c. sodium hydrate and 2 p.c. picric acid, at 100° C.

Microscope.—The author has abandoned the use of the mercury arc lamp, owing to the difficulties of manipulation and the long exposure required, though excellent photographs were obtained by its aid. A Nernst lamp with two thick filaments, so placed that their light is superposed on the illuminator of the Microscope, gives good results; the source of light is sufficiently broad to eliminate the interference fringes which give trouble when an ordinary Nernst lamp with a thin filament is used. For steel sections exposures of 2–5 minutes are usually sufficient. Several modifications in the Microscope and camera used by the author are described. It is more satisfactory to obtain high magnifications by employing objectives of higher power than by increasing the distance between plate and eye-piece.

Alloys of Copper and Aluminium.* — L. Guillet confirms the melting point curve (liquidus) of the copper-aluminium alloys obtained by H. le Chatelier, with some slight differences. To determine the curve of the "solidus" he has investigated the cooling curves of different alloys and the micrography of alloys quenched at varying temperatures. The alloys containing 8 p.c. to 14 p.c. aluminium have one and frequently two critical points. The author distinguishes seven constituents in all, three of which are compounds—Al_2Cu, AlCu, $AlCu_3$ (?)—the others being solid solutions. Their characteristics and conditions of formation are described in detail.

Constitution of Iron-Carbon Alloys.†—In an important paper dealing with Roozeboom's application of the phase doctrine to the iron-carbon system, E. Heyn points out that the science of metallography has advanced enormously with the development of the theory of solutions

* Rev. Metallurgie, ii. (1905) pp. 567–88 (4 diagrams, 28 photomicrographs).
† Iron and Steel Mag., ix. (1905) pp. 407–17 and 510–18; x. (1905) pp. 42–52 (27 figs.).

and the phase doctrine. The important part played by the Microscope in its development should not, however, be forgotten. While the phase-rule furnishes information regarding stable equilibria, the Microscope is almost the only means of investigating metastable conditions of alloys. Starting with a diagram of the critical points of iron-carbon alloys, agreeing closely with that given by Roberts-Austen, the author describes the changes which take place when cooling is sufficiently slow to permit the attainment of stable equilibrium. When the rate of cooling is somewhat accelerated, stable equilibrium does not result. Assuming that by rapid quenching from a temperature T the alloy is retained, at a lower temperature *t*, in a condition corresponding to stable equilibrium at T, a number of cases are taken and the final constitution of the alloy inferred. Such complete supercooling, however, is not possible in the case of iron-carbon alloys. The condition of an alloy rapidly cooled from a temperature T to *t* is unstable, and is intermediate between the condition stable at T and that stable at *t*. T is assumed to be above, and *t* below the critical range. Transition constituents, which must not be considered as phases, are thus formed. Martensite and troostite are well known examples of such constituents. Possibly austenite may also belong to the same category, instead of being, as Osmond regards it, a separate phase. As a means of distinguishing troostite from martensite and other constituents microscopically, 1 p.c. hydrochloric acid in absolute alcohol is recommended as an etching reagent. The author gives his reasons for doubting the occurrence of the transformation—

$$\text{martensite} + \text{graphite} \rightleftarrows \text{carbide},$$

which, according to Roberts-Austen and Roozeboom, takes place at 1000° C. Their view is not supported by experimental data. An alternative theory is advanced, the condition corresponding to the two phases, iron and graphite being accepted as stable, while the existence of carbide is due to supercooling. Carbide (cementite) is thus a metastable form.

Metallography applied to Foundry Work.*—A. Sauveur describes the various methods suitable for differentiating the constituents in a microscopical section of cast-iron. 10 p.c. nitric acid in absolute alcohol is recommended as an etching reagent. Graphite may be distinguished by examination of the section after simple polishing.

On the Magnetisation and the Magnetic Change of Length in Ferromagnetic Metals and Alloys at Temperatures ranging from −186° C. to +1200° C.†—K. Honda and S. Shimizu have measured the magnetisation and magnetic change of length of pure iron, nickel, cobalt, tungsten steel, and 12 specimens of nickel steel containing from 24 p.c. to 70 p.c. nickel, at the temperature of liquid air, at 1200° C., and at intermediate temperatures. Temperatures between −186° C. and −15° C. were obtained by surrounding the specimen by a jacket containing liquid air. Uniform slow cooling thus resulted. High temperatures were obtained by inserting the specimen in a platinum-wound electric resistance tube furnace. A platinum German-silver

* Iron and Steel Mag., x. (1905) pp. 29–32 (2 figs.).
† Journ. Coll. Sci. Tokyo, xx. Art. 6, pp. 1–63 (4 pls.).

thermo-electric couple was used for measuring low temperatures. Numerous results are given by the author; those given by the experiments on the irreversible alloys of iron and nickel are of especial interest.

CARPENTER, H. C. H., & KEELING, B. F. E.—**The Range of Solidification and the Critical Ranges of Iron-carbon Alloys.**
[A reprint of the well-known paper read before the Iron and Steel Institute in May 1904. A number of cooling curves necessarily omitted from the paper as originally published are included. A very complete investigation of the critical temperatures of iron-carbon alloys.]
Collected Researches of the National Physical Laboratory, i. pp. 229–44 (5 pls. 4 figs.).

CHARPY.—**Modification de la qualité du métal des rivets par l'opération du rivetage.**
Comptes Rendus, cxli. (1905) pp. 327–8.

FRÉMONT, C.—**Influence de la fragilité de l'acier sur les effets du cisaillement, du poinçonnage, et du brochage dans la chaudronnerie.** *Tom. cit.*, pp. 325–7.

GUILLET, L.—**Constitution des alliages cuivre-aluminium.**
[Included in the article on the same subject published in Rev. Metallurgie and abstracted above. See also J.R.M.S., 1905, p. 586.]
Tom. cit., pp. 464–7.

JOB, R.—**Some Causes of Failure of Rails in Service.**
Iron and Steel Mag., x. (1905) pp. 97–106 (8 figs.).

OSMOND, F.—**Contribution à la discussion du mémoire de M. Hadfield "Experiments relating to the effect on Mechanical and other Properties of Iron and its Alloys produced by Liquid Air Temperatures."**
[Hadfield's conclusions regarding the allotropic theory of iron, based on the behaviour of alloys at low temperatures, are disputed. The difference in the influence of liquid air temperatures on nickel steel and on manganese steel is shown to be quite consistent with the allotropic theory.]
Rev. Metallurgie, ii. (1905) pp. 595–600 (2 figs.).

SANITER, E. H.—**Etching of High Carbon Steel.**
[The specimen is dipped in absolute alcohol, then strong nitric acid, and washed at the tap.] *Iron and Steel Mag.*, x. (1905) p. 156.

Vanadium and Vanadium Steel. *Tom. cit.*, pp. 134–40.

JOURNAL

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ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1905.

TRANSACTIONS OF THE SOCIETY.

VII.—*Notes on "Aragotite," a Rare California Mineral.*

By Henry G. Hanks, Corr. F.R.M.S.

(*Read October 18th*, 1905.)

It is a very interesting and singular fact, and one I believe not generally known, that hydrocarbon minerals are almost universally associated with the ores of quicksilver in all parts of the world. The Idria mine in Austria, the Almaden in Spain, and the Huancavelica in Peru, great historical mines, all contain mineral hydrocarbons in some form. The numerous quicksilver mines of California are not only not exceptions, but bitumen is more abundant in them than elsewhere. In some California mines the quantity is so great as to materially interfere with the metallurgy of the ores. We have in California one locality where gold, cinnabar, metacinnabarite, native mercury, pyrite, stibnite, and bitumen are associated in a coating lining rock cavities; at another a jet of natural gas, which had been burning for many years, was extinguished by the superintendent of an adjacent quicksilver mine, who informed me that he found crystals of cinnabar lining the throat of the opening through which the gas escaped; these he scraped off and re-lighted the gas. Some months after he again extinguished the flames, and found a new and copious crop of crystals. This statement I have no reason to doubt.

In this connection there are several points of special interest. The reason of the almost universal presence of bitumen in quicksilver mines has never been explained, and the question, What part do the minerals cinnabar, stibnite, bitumen, and in some

cases gold, severally play in solfataric phenomena so common in our state? remains unanswered.

At a meeting of the California Academy of Sciences, held April 1st, 1872, Mr. F. E. Durand read a paper entitled "Description of a New Mineral from the New Almaden Mine."

"This mineral, of a very bright, pure yellow colour, is found impregnating a crystalline, silicious dolomite; it can be very easily separated from the dolomite by sublimation. On warming in a glass tube a small amount of the substance, it volatilises when dark red, and gives a strong yellow sublimate which appears amorphous, but which, when placed under the Microscope, shows some very fine needle-like crystals.

"If heated very quickly, it carbonises and gives a residue of carbon, and produces an empyreumatic odour; strong acids have no action on it.

"When tested for sulphur or arsenic, it does not appear to contain any trace of those substances, nor any metal. This mineral seems to be a kind of volatile hydrocarbon, probably belonging to the class of 'idrialine.'

"When treated by the ordinary solvents of carburetted compounds—oil of turpentine, alcohol, or ether—it appears to be entirely insoluble. On some specimens of cinnabar from the Reddington mine the same substance is found in small scales; in fact, all the characters show that this mineral is a new substance, and for it I have adopted the name of Aragotite." *

The publication of Mr. Durand's paper caused a considerable demand for specimens, for which there was no supply. The small specimen he examined was all found in the New Almaden mine. Mr. J. B. Randol, the superintendent, made every effort to find more, and instructed his miners to search for it, which they did without success. But the name found a permanent place in scientific text-books and catalogues of mineral dealers; it was accepted as a true mineral species when there were no specimens—except, perhaps, the one presented to the Academy by Mr. Durand with his paper.

In 1893 Mr. E. A. Hardy sent me some fine specimens of a yellow hydrocarbon mineral which I have no doubt is Aragotite.

This mineral occurs in the Aetna quicksilver mine, Napa County, California. The following are extracts from Mr. Hardy's letter dated July 13, 1893:—

"It is found in small quantity on or near the contact of the sandstone with argillite; the first found was about 400 feet below the surface—what I send you at this time was taken out at seven feet. It has always occurred with cinnabar until within a few days, when a small pocket was met with on the above mentioned

* Proceedings of the California Academy of Sciences, iv., 1868–1872, p. 218.

contact, there being no cinnabar in close proximity. I am informed that it has never been found in any other part of the mine."

From this locality I obtained a quantity sufficient to enable me to verify all my experiments by several repetitions.

It has the general appearance of refined pine resin (rosin) used by musicians; colour, honey yellow; transparent; specific gravity 1·1; sinks gently in distilled water; electrical by friction; very brittle and easily frangible; may be crushed between the fingers without difficulty; fracture, sub-conchoidal and splintery; easily rubbed in water to a white, mealy, slightly adherent powder. It is very fusible, hardens again on cooling; begins to soften at 110° F., and to melt at 125°; at 140° it adheres to the cold point of a knife-blade, and may be drawn out in attenuated threads; at 150° it is a syrupy fluid; at 212° it melts into drops, and at a higher temperature, but below redness, it flows freely. It is not decomposed at a high heat; in a platinum dish it is driven from the centre and returns down the sides of the vessel in little streams, subliming in part at the same time in aromatic fumes. If ignited, it burns with a smoky, yellow flame, leaving a very little white ash. If the heat is slowly applied, it first blackens to carbon, possibly in part by the decomposition of cinnabar, which it contains mechanically in minute proportions.

The mineral is soluble with difficulty, or only partly so, in alcohol, but perfectly in spirit of turpentine, ether, and petroleum.

This is the only important discrepancy in the two descriptions; Mr. Durand does not say that his specimen was insoluble, but that "it appears to be." This uncertainty is perhaps owing to the small quantity at his disposal.

The mineral floats in drops on the surface of boiling nitric or hydrochloric acid without decomposition. A portion placed on a glass slide, heated sufficiently to liquefy it and allowed to cool slowly on a thick iron plate, was examined microscopically and found to show a few imbedded, obscure crystals, and some beautiful, exceedingly minute, transparent, perfect crystals of scarlet colour, which reflected light from brilliant planes. These remarkable crystals, which seem to be present by accident, have the appearance of, and are with but little doubt, cinnabar. The diameter of the largest was 0·003 inch, and the smallest 0·0005.

Heated in a closed glass tube the mineral sublimed, or distilled without decomposition; examined microscopically, long black, acicular crystals and stellate bodies were observed in the distillate; these were probably black sulphide of mercury (metacinnabarite) and no doubt extraneous and accidental. In a glass tube open at both ends, I obtained a yellow sublimate resembling that described by Mr. Durand; the tube was then cut into short sections, wrapped separately in paper and cautiously broken by gentle blows of a small hammer; the concave fragments so obtained

containing the sublimate, were examined under the Microscope. The instrument revealed many minute, cryptocrystalline, stelliform tufts connected in some cases by long, very slender bodies, which I believe to be crystals of sublimation and perhaps those described by Mr. Durand.

Owing partly to the difficulty of decomposing this mineral by heat, and partly to want of skill and practice, I made several unsuccessful attempts to reduce it to its elements in a combustion furnace. I then sent a sample to Dr. Ernst Huetlin, of Freiberg, Germany, who had a high reputation as an organic chemist, and received from him the following result, a mean of three determinations:—

Carbon, per cent.	88·10
Hydrogen „	9·17
	97·27

Mr. Durand thought his mineral might be some modification of idrialite, which I have reason to doubt, and I have placed the physical characters of the two minerals side by side for comparison.

	Idrialite.	Aragotite.
Carbon	94·9	88·10
Hydrogen	5·1	9·17
Colour	brownish black	honey yellow
Streak	red	white
Hardness	1·5	1·0
Specific gravity	1·5	1·1
——	opaque	transparent

As far as I know, this is the first notice and examination of this mineral since its discovery in 1872.

Fig. 158.

NOTE.

Electrical Warm-Stage.

By Cecil R. C. Lyster.

At the June Meeting the inventor exhibited and gave the following description of an improved form of warm-stage (fig. 158, Pl. VIII.).

A glass cell, 4 by 3 by $\frac{1}{4}$ inches, is grooved in the shape of the letter U, with a $\frac{3}{4}$-inch circular opening in the hollow of the U and a small space for thermometer.

This groove is filled with kryptol, a mixture composed of silicate, graphite, and carborundum. Electrodes with terminal screws are fitted at each end; these act as a resistance, and so produce the necessary heat. When a current of 100 volts from the ordinary lighting mains is passed through it, the temperature rises to 100° F. This temperature can be regulated as required by means of a small sliding resistance.

Slight variation in the voltage does not affect the temperature given out from the kryptol, and so the stage is maintained at an even temperature for any length of time.

The amount of current consumed is about 250 milliamperes. This is so small that it would not be recorded by an ordinary meter.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Origin of Double Monstrosities.‡—Anton Förster gives a critical account of the various interpretations of double monstrosities. The view that asymmetrical double-structure may be preformed even in the unfertilised ovum, is not confirmed by experiment. The view that a bi-nucleate ovum gives rise to duplex development is neither confirmed nor excluded. Polyspermy as a factor is excluded by the experimental results. Artificial disturbances suggest that symmetrical double-developments may be brought about by operating on the fertilised ovum, e.g. by a separation of the first blastomeres, or, much more probably, by a displacement of the cellular material during segmentation, or in the blastula and gastrula stages. The separation and displacement may be due to osmotic pressure or to mechanical causes. Two embryonic areas are established, and the result differs with the degree of their subsequent coalescence. There is a long series leading up to twins with one amnion.

Studies on the Placenta.§—J. Hofbauer discusses the histology, bio-chemistry, and bio-physics (movements and growth-changes of the villi) of the human placenta. The placenta is an assimilating organ for iron, albuminoids, fats, and oxygen; it produces several ferments with specific functions; it is no mere filter, but an organ with complex chemical processes, and with internal secretion. The placentar transport of bacteria, agglutinins, and anti-toxins is discussed.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This Section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Verh. Phys. Med. Ges. Würzburg, xxxvii. (1905) pp. 235–62.

§ Grundzüge einer Biologie der menschlichen Placenta. 8vo (Wien und Leipzig, 1905) ix. and 175 pp., 5 pls. and 2 figs.

H. Strahl * describes the semiplacenta diffusa incompleta of *Tragulus javanicus*, and the simple and double discoidal placenta of American monkeys.

Fœtal Membranes.†—A. J. Resink discusses the stages in the development of the fœtal membranes, distinguishing arch-embryonic, arch-placentar, and neo-placentar stages, and attempting a phyletic interpretation. But we cannot do more than record the subject of his investigation.

Development of Chromosomes in the Selachian Ovum.‡—J. Marechal describes the various stages in the development of the chromosomes in the ovum of *Pristiurus*, *Scyllium*, and other Selachians. He discusses the resting stage, the interruption of the rest and the reconstitution of the chromosomes, the synapsis, the dissolution of the compact mass of synapsis threads, the thick coil (noyaux pachytènes), the doubling of the chromosomes, and the growth period (strepsinema, noyaux diplotènes). He suggests a hypothetical answer—the *Verklebungstheorie* of von Winiwarter—to the two questions: (1) what is the import of the anti-synaptic duplicity of the threads and the post-synaptic doubling of the chromosomes of the thick coil; and (2) how the numerical reduction of chromosomes is effected.

Spermatophores of Newts.§—The late E. v. Zeller left a manuscript memoir on the spermatophores of newts and their relation to the cloacal gland. This has been edited by C. B. Klunzinger and E. Jacob. The gelatinous spermatophores are vase-like, with an adhesive stalk and a cup which bears the mass of spermatozoa. They differ in details in the various species of *Triton*, and the author described those of *T. alpestris*, *T. cristatus*, and *T. tæniatus-palmatus*, *T. viridescens*, *T. torosus*, and other species. The vase is composed of large gelatinous spheres, closely apposed like a mosaic, each a peculiarly modified cell. It is formed by the cloacal gland, and each of the numerous tubules of the gland forms a gelatinous sphere. The stalk is fixed to the substratum after expulsion from the cloaca, and almost simultaneously it is filled with sperms. Sometimes as many as five are fixed and filled in rapid succession. The author gave full details of the whole process, and of the way in which the female secures the spermatophores. The nature and function of the ventral and pelvic glands is also discussed.

Corpuscle of Human Sperm-Cells.‖—Wederhake has investigated the question of the "Eimerian" corpuscle, and finds that it does not occur in every sperm head, but only in some. It is to be found constantly in the spermatids which have a certain differentiation of the nucleus. The corpuscle, on account of its position, structure, staining capacity, and occurrence in a definite type of sperm cell, and also its relation to the development of the nucleus of the sperm, is to be regarded as a corpuscle *sui generis*. Analogy with Meves's observations

* Anat. Anzeig., xxvi. (1905) pp. 425-30.
† Tijdschr. Nederland. Dierk. Ver., viii. (1904) pp. 159-201 (1 pl.).
‡ Anat. Anzeig., xxv. (1904) pp. 383-98 (25 figs.).
§ Zeitschr. wiss. Zool., lxxix. (1905) pp. 171-221 (2 pls.).
‖ Anat. Anzeig., xxvii. (1905) pp. 326-33.

on the sperms of other animals would lead to the assumption that it is to be regarded as the idiosome corpuscle of the human sperm, and not as, according to Eimer, a remnant of the nuclear corpuscle of the spermatid nucleus.

Development of Islands of Langerhans in Human Embryo.*—H. Küster finds that these appear even in the early embryonic stages as anatomically differentiated formations in the pancreas. They arise as a budding upon the glandular ducts, and early show three marked characteristics: (1) the nuclei lie centrally, the cytoplasm towards the outside; (2) the cells are arranged in columns; (3) there are intimate relations with the capillaries. The separation of the islands from the gland ducts takes place very early; their growth ceases towards the end of fœtal life, and from that time onward they remain throughout life unaltered in structure and in size.

Development of Megalobatrachus maximus.†—L. P. de Bussy gives a full account of the cleavage and early stages in the development of this giant salamander, and compares his results with those obtained in reference to other Amphibians, Dipnoi, "Ganoids," and the lamprey.

b. Histology.

Morphology and Biology of the Cell.‡—A. Gurwitsch has produced an introductory work on the cell. It is divided into four parts: (1) Statics and dynamics of the cell; (2) the metabolism and functions of the cell; (3) the multiplication of the cell; and (4) the cell as "organism" and "individual."

Spiral Coiling of Nucleus of Smooth Muscle Cells.§—G. Schlater agrees with E. Forster that the nucleus of the smooth muscle cell may show manifold twists and bends, but thinks that Forster exaggerated the importance of spiral coiling. He entirely rejects the idea that the heart-fibres and other fibres in Amphibians contract by spiral coiling. The view that the spiral nucleus of the smooth muscle cell coils passively when the cell contracts, must be corrected by a recognition of the autonomy and independence of nuclear form-changes.

Experimental Phagocytosis.‖—L. Mercier has experimented with the frog, introducing fragments of tadpoles (muscle fibres and epithelial cells) into the dorsal lymphatic sacs, and has had the satisfaction of entirely confirming Metchnikoff's description of phagocytosis.

Cell Migration in Cæcum and Mid-gut of Amphioxus.¶—Boris Zarnik describes remarkable changes in the liver (cæcum) and mid-gut of *Amphioxus* (10–22 mm.) during the growing period. The normal lining of the cæcum and mid-gut is a high cylindrical epithelium, on

* Arch. Mikr. Anat., Bd. 64 (1904) pp. 158–72 (1 pl.).
† Tijdschr. Nederland. Dierk. Ver., viii. (1904) pp. 267–378 (10 pls.).
‡ Morphologie und Biologie der Zelle. 8vo (Jena, 1905) xix. and 437 pp., 239 figs.
§ Anat. Anzeig., xxvii. (1905) pp. 337–45 (5 figs.).
‖ Arch. Zool. Expér., iii. (1905) Notes et Revue, No. 8, pp. cxcix.–cciv. (5 figs.).
¶ Anat. Anzeig., xxvii. (1905) pp. 433–49 (figs.).

which the author found no cilia. This undergoes remarkable degeneration—with amitosis, accumulation of waste, and dissolution—down to a zone or girdle of thickened hypoblast in the first third of the digestive region. There is a loosening and emigration of cells, till only isolated islands are left on the wall of the cæcum. But in animals about 22 mm. in length there is restitution of the epithelium till no traces of the lesions are seen. The process of restitution seems to be due partly to the activity of the island left on the cæcum wall and partly to migrations from the mid-gut.

Germination and Growth of Artificial Cells.*—Stéphane Leduc has produced an "artificial cell" by allowing a drop of sugar solution (with traces of ferrocyanide of potassium) to fall into a solution of sulphate of copper. The drop is covered by a membrane of ferrocyanide of copper, permeable to water, impermeable by the sugar. This mimic cell has the faculty of swelling and growing, and also of giving out prolongations which grow slowly, like radicles and plumules. He discusses the physics of the business.

Nerve-endings of Nail layer in Man.†—A. S. Dogiel makes a comparison of the nerve apparatus in the skin of the finger-tip and in the cutis of the nail layer. In the stratum papillare of the nail layer are present only unencapsuled nerve-clumps ("Nervenknäuel"), interpapillary nets, and thread nets; the manifold forms of encapsuled nerve apparatus which are constantly met in the stratum papillare of the skin of the finger tip, as also certain forms of unencapsuled apparatus, e.g. the papillary "Büschel" of Ruffini, are here entirely absent. The superficial and the deep cuticular strata of the nail layer include a large number of tree-like end branchings, and a very limited number of unencapsuled "Knäuel" and encapsuled apparatus in the form of modified Vater-Pacini corpuscles; the typical Vater-Pacini corpuscles—peculiar corpuscles with plate-like endings similar to the typical end-branchings of Ruffini—are not present here. In the epithelial ridges the Merkel's touch corpuscles are absent; only the inter-epithelial end-branchings are present.

Nerve-endings.‡—Romeo Fusari gives an account of the nerve-terminations in the striped muscle of the Ammocoete stage of *Petromyzon branchialis*.

Central gustatory Paths in Brain of Bony Fishes.§—C. Judson Herrick has traced within the brain the gustatory pathways, and mapped out the reflex paths for the various types of gustatory reaction which have been actually observed in the feeding activities of these fishes. The gustatory paths are grouped under the following sections:—Peripheral neurones—gustatory neurones of the first order; nucleus gustus primus; tractus gustus secundus descendens; tractus gustus secundus ascendens; nucleus gustus secundus inferior; nucleus gustus secundus superior; tractus gustus tertius.

* Comptes Rendus, cxli. (1905) p. 280.
† Arch. Mikr. Anat., Bd. 64 (1904) pp. 173–88 (2 pls.).
‡ Atti R. Accad. Sci. Torino, xl. (1905) pp. 1078–88 (1 pl.).
§ Journ. Compar. Neurol. and Psychol., xv. No. 5 (1905) pp. 375–456.

Eye of Protopterus annectens.*—Hosch gives some notes on the structure of the eye in *Protopterus*, and discusses the phylogenetic significance of the facts elucidated. He considers that, apart from the cornea, which in *Protopterus* has special adaptive features, a genetic origin of its important constituents from the fish eye is indicated; at the same time the eye of *Protopterus* agrees in all essential points with that of the next higher vertebrates, the Urodeles.

Lacteal Secretion.†—Brouha reviews the various theories as to the nature of the lacteal secretion. He has studied the process in the mole, the bat, and the cat, and finds that there are two distinct phases: (1) a brief necrobiotic process, which involves the partial sacrifice of the body of the cell; and (2) an uninterrupted merocrinal process, which goes on through the whole secretory cycle. The former leads to the expulsion of a small portion of cytoplasm which breaks up, liberating its fatty or nuclear contents. The purely secretory or merocrinal phase leads slowly to the distension of the mammary acinus; the epithelium is reduced to a delicate limiting membrane, and fatty globules are continuously secreted into the alveolus, which is eventually evacuated.

Human Anal Glands.‡—J W. T. Walker has investigated in the human fœtus, the coccyx gland which is known in all individuals from birth to the end of life. He found it clearly in the fœtus. The youngest case examined was in the sixth lunar month. The gland consists essentially of specific cells, which surround twisted and much dilated capillaries, the central blood spaces. These cells are grouped in numerous masses, which are supported and held together by connective tissue; certain masses are in the form of little nodules detached from the chief part of the gland. Whilst in the fœtus the gland appears only as a cell mass, interpenetrated by twisted capillaries; post-fœtally the connective tissue penetrates this mass, dividing it up into numerous cell groups, and certain of the blood spaces disappear. The structure points to a fitting into the blood circulation; it effects a local slowing down of the same, thereby bringing the blood into closer connection with the gland-cells. An endothelial layer always separates the blood from the gland-cells. The gland has no duct, and an internal secretion may be regarded as its most important function.

Glands of Frog's Skin.§—J. Arnold makes some notes on the structure and secretion of the glands of the frog's skin. He has not been able to settle the question as to whether there are one or more kinds present; mucus and granular glands have been regarded as modifications of one and the same type. At any rate one form cannot change to the other, and no mixed types were found such as have been described in *Triton*. The significant point of the results is the observation that in the granular and mucus glands the formation of secretion is effected by the transformation of the plasmosomes of the cytoplasm into secretory granules.

* Arch. Mikr. Anat., Bd. 64 (1904) pp. 99–110 (1 pl.).
† Anat. Anzeig., xxvii. (1905) pp. 464–7.
‡ Arch. Mikr. Anat., Bd. 64 (1904) pp. 121–57 (1 pl.).
§ Op. cit., Bd. 65 (1905) pp. 649–65 (1 pl.).

Minute Structure of Gas-Gland in the Swim-Bladder.* — Karolina Reis and J. Nusbaum give an account of the gas-gland in *Fierasfer*, *Ophidium*, *Charax*, *Macropodus*, and other Teleosteans. In its best developed portion, nearest the vascular organ or *rete mirabile*, the gland shows a layer of cylindrical epithelium with many tubular diverticula. These branch, and their blind ends often fuse, the cylindrical epithelium becoming cubical or polygonal at the areas of fusion. At other places, where less developed, the epithelium has only a few short blind diverticula. The secretion of the gas seems to be associated with a breaking down of blood corpuscles, and granular debris is often seen in the blood-vessels of the gland. The gas is secreted in the form of minute vesicles in the plasma of the glandular cells; these coalesce, and doubtless pass into the lumen of the swim-bladder. The authors describe in particular the trophospongia of the cells, for the gas-gland is a very suitable object for the study of this structure.

Fat-Cells in Glandulæ vesiculares of Cattle.†—G. Illing describes at the base of the secreting epithelium of the glandulæ vesiculares and their duct, sphere- or oval-shaped bodies about 17 μ in diameter. They form part of the glandular epithelium, and occur both as a continuous and an interrupted layer. They consist of fat cells of a peculiar kind, distinguished by a special arrangement, form, and size, but above all by their place of occurrence, from the usual fat-cell.

Structure of Seminal Duct in Amphibia.‡—H. Gerhartz gives an account of the macroscopic appearance and histology of the seminal duct and vesicle in *Rana* and *Triton* at the pairing time and throughout the cycle of changes which they undergo. The involution and regeneration of the seminal vesicle goes hand in hand with corresponding stages in the testis of *Rana fusca*—i.e. it increases in size when the formation and maturation of sperms begin, whilst after emission there is marked retrogression. The vesicle possesses a glandular character, and its secretion is to be found throughout the whole year quite independently of the increase in size which accompanies the development of the testis. In *Triton* the duct also is probably glandular.

Structure of Wing-Feathers.§— E. Mascha has made a detailed study of the minute structure of the wing-feathers of the pigeon and other birds. Among the most noteworthy discoveries made are the recognition of the variability in the size and structure of the secondary fibres, of the importance of their ventral ridge, of the variation of the hook fibres, and of the constancy of the curved fibres. According to the nomenclature used, the vanes are composed of secondary quills which rise obliquely from the upper part of the primary quill, and of the tertiary fibres (hook-fibres and curved fibres) rising in a similar manner from the secondaries. The author has much to say regarding the ventral horn-ridge of the secondary quills, the complicated structures at the origin of the tertiary fibres, the differences between hook-fibres and

* Anat. Anzeig., xxvii. (1905) pp. 129–39 (2 pls.).
† Arch. Mikr. Anat., Bd. 66 (1905) pp. 121–7 (1 pl.).
‡ Op. cit., Bd. 65 (1905) pp. 666–98 (4 pls.).
§ Smithsonian Misc. Coll., iii. (1905) pp. 1–30 (16 pls.).

curved fibres, and so on. It is interesting to notice that the number of hooks on each hook-fibre (2–8) is constant in the same species.

c. **General.**

Antarctic Fauna.*—R. von Lendenfeld makes some comments on the animals collected by the 'Discovery,' as reported by T. V. Hodgson and E. A. Wilson.† The abundance of sponges (about 50 species) was a striking feature. An *Umbellula* was found near the ice-wall at a depth of 914 metres. Echinoderms abounded in Ross's Sea, e.g. *Asterias brandtii*, *Ophiosteira antarctica*, *Ophionotus victoriæ*. A *Nereis* was found symbiotic with an Alcyonarian. Purple-brown and sometimes white Nemerteans up to a metre in length and 2·5 cm. in breadth were common. Long brownish brittle ribbons were often found, which were first referred to Nemerteans and then to a Cephalopod. [They are more probably parts of a large Siphonophore.] The white seals and the penguins feed abundantly on the large *Euphausia australis*. The ten-legged *Pentanymphon antarcticum* is noteworthy. About 50 species of Molluscs were obtained, and *Cephalodiscus* was abundant. Many fishes were collected, notably species of *Notothenia* and *Trematopus*. Von Lendenfeld refers to the principle of economy in organic nature in connection with the suppression of colour in many forms.

Zoologischer Jahresbericht.‡—Paul Mayer continues to edit the invaluable Naples Jahresbericht, and to bring it out in good time. Many of the summaries are models of their kind. The pagination for each class is independent.

Fauna of Wells.§—J. E. Lord has some notes on the fauna and flora of English wells and surface troughs. He directs attention to various species of *Amœba* and to other Rhizopods: *Euglypha alveolata*, *E. ciliata*, *Trinema acinus*, *Cyphoderia ampulla*, and *Pamphagus hyalinus*. He found *Stentor roseus*, *Euglena deses*, *Astasia*, and other Infusorians. Rotifers were represented chiefly by a few Bdelloida, which are usually moss-lovers. He notes *Rotifer vulgaris*, *Philodina roseola*, *P. citrina*, *P. megalotrocha*, *Diaschiza gracilis*, and *Diglena forcipata*. The wells also contained *Anguillula*, *Tubifex*, *Canthocamptus*, *Cypris*, and insect larvæ.

Persistence of Trade Impressions.‖—R. J. Anderson refers to the structural features induced as modifications by the peculiar exercises involved in certain trades. The shoemaker has his sternum affected by the pressure of the boot and last, added to the muscle tension used in sewing. "The skeletal characters do not end when the race ends, not necessarily at least, the *status quo* is not immediately restored, and a depressed sternum or modified sternum may be present in all the members of a family who have not begun to practise the craft. The sebaceous glands also get large, with large patent openings, or swell with accumulated products." In tailors the hair is apt to disappear from the outer

* Biol. Centralbl., xxv. (1905) pp. 574–80.
† Geogr. Journ., xxv. pp. 392–401.
‡ Zool. Jahrb. 1904 (Berlin, 1905).
§ Trans. Manchester Micr. Soc., 1905, pp. 55–7.
‖ Anat. Anzeig., xxvii. (1905) pp. 467–8.

surfaces of the legs: in descendants who do not follow the hereditary craft the characteristically smooth skin surfaces may be seen. "The absence of hair from the inner side of the leg in jockeys is not difficult to observe, although hard to trace beyond the professional family." We hope Professor Anderson will publish more precise data.

Form of the Trunk-Myotome.*—J. W. Langelaan describes the form of the trunk-myotome in the lamprey and the dog-fish. His method is based on the dissection of the intersegmental tissue. The trunk-myotome of *Petromyzon fluviatilis* is in general a crescent, with the cornua directed towards the head and slightly inclined to each other. In *Acanthias vulgaris* the form is complicated. It is differentiated into three parts by a process of infolding, the lines of folding being parallel to the sagittal axis of the body.

Curves of Growth.†—M. Stefanowska has weighed a brood of chickens at regular intervals and has followed them into adult life. The curves of increase in weight are practically the same for the two sexes, but irregularities appeared in the females when egg-laying began. To begin with, the weight increased rapidly with age, but a point of inflection appeared when the cock attained 77 p.c. and the hen 93 p.c. of the maximum. This occurred about midway in the period required to reach the maximum. Thereafter growth in weight became slow and soon became stationary. In general the curves correspond to those obtained for mice and guinea-pigs. Mathematical expressions of the results are given.

Brain Weight in Vertebrates.‡—Aleš Hrdlička submits a large series of data showing the weight of the brain in proportion to that of the body in a series of mammals and birds.

Biological Theories.§—Alfonso L. Herrera expounds in a handy volume his personal views in regard to the fundamental problems of biology. His primary proposition is that all the material phenomena of organisms are interpretable in terms of known physico-chemical forces, and he devotes a considerable part of the book to interpretations of protoplasmic structure, cell-division, and the like, in terms of chemistry and physics. Apart from his own particular views, he gives terse accounts of the various important contributions to biological theories, not forgetting Mendel, and coming down to De Vries. One of the features of the book is the number of clear synoptical tables, showing the phases of opinion on many subjects. It should be very useful to Mexican students.

Ridges on the Sole and Palm in Primates.‖—Otto Schlaginhausen has made an elaborate study of the patterns on the plantar surface of lemuroids, monkeys, and man, with some reference also to the palm surface. He discusses the origin of the ridges and their coalescence

* K. Akad. Wetensch. Amsterdam, Proc. Section of Sciences, vii. (1904) pp. 34–40 (1 pl. and 4 figs.). † Comptes Rendus, cxli. (1905) pp. 269–71.

‡ Smithsonian Misc. Coll., iii. (1905) pp. 89–112.

§ Nociones de Biologia, Mexico, 1904, 251 pp., 84 figs.

‖ Morphol. Jahrb., xxxiii. (1905) pp. 577–671 (76 figs.); xxxiv. (1905) pp. 1–125 (194 figs.).

into complexes, and also the evolution of the particular patterns. His data are utilised in relation to the phylogeny of the various groups of primates.

Evolution of Mammals.*—Charles Depéret returns to his point, in answer to Boule's critique that the alleged pedigrees of Ursidæ and Equidæ lack reality. He was himself led astray by regarding similar functional adaptations as proofs of filiation, but he has rid himself of this fallacy. "Palæontological evolution has to become the history of what did really occur in the past, and not of what might have occurred." The difficulty is to achieve this desirable end.

Skull of Echidna and Reptiles.†—E. Gaupp has made a study of the development of this skull. The following amongst other interesting facts appear to be made out. The pterygoids of Echidna show very marked agreements with those of reptiles; there are special similarities to the posterior sections of turtle pterygoids. The view that these bones are homologous receives support, while on the other hand the similarity which the turtle pterygoid shows with the so-called mammalian pterygoid cannot be taken as evidence of a like homology. The mammalian pterygoid is referable to the parasphenoid of the lower vertebrates, and retains in its place at the base of the skull a very ancient characteristic. The turtle pterygoid has reached the same position by extension from the side in a quite secondary manner. The parasphenoid as a rule blends early with the basi-sphenoid; a like tendency to fusion with the sphenoidal elements can be recognised in the parasphenoid lamellæ of many mammals.

New Squirrel from Burma.‡—Oldfield Thomas describes *Sciurus haringtoni*, sp. n., from the Upper Chindwin River, a very peculiar squirrel of a pale creamy-buff colour with whitish tail and without the small upper premolar present in all other known oriental squirrels.

Notes on Skull of a Lion.§—O. Charnock Bradley describes several peculiarities in the skull of a young lion, the significance of which is discussed. The skull in question possessed an ossicle, roughly triangular in shape, situated between the lachrymal, frontal, and maxillary bones. Such an "ossiculum maxillo-frontale," it appears from the cases cited, is of widespread occurrence amongst mammals. Other features of this skull are the presence of a pair of asymmetrical accessory nasal bones; and on the right side, a sutural bone between the intermaxillary and superior maxillary bones on the margin of the alveolus for the canine tooth. The author thinks the presence of this bone is to be associated with the large size of the canine tooth.

Innervation and Development of Tactile Feathers.‖—Ernst Küster finds that the main innervation of tactile feathers, or vibrissæ, is by touch-corpuscles; the nerve entering the papilla has only a vasomotor

* Comptes Rendus, cxli. (1905) pp. 22-3.
† Anat. Anzeig., xxvii. (1905) pp. 273-310.
‡ Ann. and Mag. Nat. Hist., No. 93 (1905) pp. 314-15.
§ Anat. Anzeig., xxvii. (1905) pp. 317-23.
‖ Morphol. Jahrb., xxxiv. (1905) pp. 126-48 (4 pls.)

significance. The tactile feathers occur as primordia on the embryo; there is no increase after hatching. They correspond to the sinus-hairs in mammals, and might well be called sinus-feathers. They are most developed in nocturnal birds, and their primordia degenerate where there is no use for them. Those at the root of the bill are helped by those round the eyes.

Hermaphroditism in Testudo græca.*—H. B. Fantham has found in an examination of about a dozen male tortoises that two of the specimens possessed abnormal genitalia. One, in addition to the normal male organs, epididymes, vasa deferentia, and penis, possessed well-developed gonads, one of which was an "ovotestis," and well-developed oviducts. The other specimen, an undoubted male, possessed rudimentary Müllerian ducts opening into the cœlome. The anatomy and histology of these organs are described.

Effect of Ovarian Extract of Frog.†—G. Loisel subjected guinea-pigs to subcutaneous injections of extract of frog's ovary, and found that in course of time sterility and baldness followed. The young were fewer in number at each successive birth, until there were only two instead of six or seven, while the number of occurrences of pregnancy was reduced to less than half the normal. Similar results have been observed to follow in mammalia after the injection of oil of phosphorus. The possibility that the baldness may be due to a parasitic malady of the skin is not excluded.

Caudal Hearts and Sinuses in Teleosts.‡—G. Favaro distinguishes three different things: (1) the sinus lymphaticus caudalis; (2) the cor (lymphaticum) caudale; and (3) the sinus venosus caudalis. These may be combined, e.g. in tench and trout, or there may be no lymphatic sinus (*Belone*), or no sinus at all (*Anguilla*), or no caudal heart (*Cyprinodon*), or no sinuses and no heart (*Solea*), or no sinuses, no heart, and no caudal vein (*Lophius*).

Habits of West Indian Whitebait.§—Austin H. Clark makes some interesting notes on the "tri-tri" (*Sicydium plumieri*), which inhabit mountain streams in the West Indies, and migrate in the dry season to the sea, where they lay their eggs and apparently die. The young fry ascend in a continuous line like young eels. When stranded they show remarkable tenacity of life, and may live for several hours exposed to the full rays of the sun.

Ceylonese Fishes.‖—Jas. Johnstone reports on 117 species (73 genera) of fishes collected by W. A. Herdman around Ceylon. One species, *Salarias furcatus*, is now described for the first time. A series of stages, and the adult female of *Psettylis ocellata* Alcock, were obtained, also *Solea oculus* Alcock, of which only two specimens have hitherto been obtained.

* Ann. and Mag. Nat. Hist., No. 92 (1905) pp. 120–6 (1 pl.).
† Comptes Rendus, cxl., No. 11 (1905) pp. 738–41.
‡ Anat. Anzeig., xxvii. (1905) pp. 379–80.
§ Amer. Nat., xxxix. (1905) pp. 335–7.
‖ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 201–22 (2 pls. and 2 figs.).

Notes on Myxine.*—F. J. Cole notes a number of interesting points in the anatomy of *Myxine*. There are two hepatic ducts opening directly into the large gall-bladder. The bile duct itself opens between these two apertures. The gall-bladder of *Myxine*, therefore, has three openings. In the kidney there is generally no unbroken connection between the so-called pro- and mesonephros of *Myxine*, although isolated Malpighian bodies occur in the intermediate region. In one specimen the segmental duct was continued forward as a tube in the pronephros. An interesting fact regarding the sexual organs is that there is no protandric hermaphroditism; every adult is hermaphrodite, but either predominantly male or female. That is, there is either a mature testis and a rudimentary ovary, or a mature ovary and a rudimentary testis. The thyroid is a diffuse organ consisting of a number of closed independent alveoli scattered along the whole course of the ventral aorta. The author has traced a connection, by means of fine channels lined by epithelium, between the posterior surface of each afferent branchial artery and the peribranchial sinuses, which suggests the likelihood of other connections between the bloodvessels and the so-called lymphatic spaces in other parts of the body. Several variations in the gills and their vessels are recorded.

Tunicata.

Fertilisation in Solitary Ascidians.†—S. Guthers has studied the question of self- and cross-fertilisation in *Phallusia mammillata* and *Ciona intestinalis*. The number of cases dealt with was not very great, but nevertheless the results were very consistent. In the case of *Phallusia* all or nearly all the self-fertilised eggs developed; in *Ciona*, none or only a trifling percentage did so. In both animals all or nearly all the cross-fertilised eggs yielded larvæ. *Phallusia* occurs almost always singly, while *Ciona* is found in groups, whose members are united at the base by the adherent growth of the tests. The opportunities for cross-fertilisation in the former are thus much fewer than in the latter animal.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Muscles of the Mantle in Cephalopods.‡—F. Marceau has studied the structure and the mode of contraction of the muscles of the mantle in *Octopus*, *Sepia*, and *Loligo*. The fibres of the mantle have the form of elongated spindles, with a contractile sheath of fibrillar lamellæ coiled in a spiral around the granular nucleated axial column of protoplasm. Owing to the helicoid structure, and perhaps to a slight heterogeneity in the fibrils, the mantle-muscles contract almost like ordinary striped muscle.

Ceylonese Cephalopods.§—W. E. Hoyle reports on the Cephalopods collected by W. A. Herdman off Ceylon. The greatest novelty is a

* Anat. Anzeig., xxvii. (1905) pp. 323–6.
† Arch. Mikr. Anat., Bd. 64 (1904) pp. 111–20.
‡ Comptes Rendus, cxli. (1905) pp. 279–80.
§ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 185–200 (3 pls.).

small *Octopus*, with branched processes scattered over the body, which the author names *Polypus arborescens* sp. n. A very striking peculiarity is the preponderance of Octopods as compared with Decapods. The peculiar, possibly protective, papillæ on *Polypus arborescens* are described at length, but their nature remains somewhat enigmatical.

β. Gastropoda.

Senility in Gastropods.*—Burnett Smith makes a suggestive contribution on this subject. In the last whorl, or in the last few whorls of many Gastropods of different groups, there are characters of senility. They are the last characters which occur on the shell, and foreshadow the death of the individual. "Senile species or genera of fossil Gastropods never transmit descendants to later geologic formations, but represent the end members of short branches on the phylogenetic tree." The rate of evolution varies greatly. "The forms in which the evolutional rate is rapid are bizarre senile offshoots." An accident to an individual may bring about a sudden appearance of senile characters, which are sometimes "extra-specific"—i. e. found in some senile offshoot from the same stock. Unequal acceleration of characters seems to be a common phenomenon, and features which occurred at the same time in an ancestor are apt to be widely separated in the ontogeny of a descendant.

Habits of Tortoise-Shell Limpet.†—M. A. Willcox describes the life and habits of *Acmæa testudinalis*. The size seems to be correlated not necessarily with a low, but with an equable temperature. In autumn they seem to retire a little below tide-mark. The fastest crawling observed was about three inches per minute. There is presumptive but inconclusive evidence as to a homing habit. The food is exclusively vegetable. In certain circumstances atmospheric air may be respired. Evidence of the perception of light and darkness, of a temperature sense, and of great tactility, is adduced. The tentacles, the gills, and the whole body surface are tactile. The ovary, when ripe, has a crushed-strawberry colour, and the testis is golden brown; otherwise the sexes are alike. The eggs are imbedded in a layer of mucus. There is some inconclusive evidence that fertilisation is internal. The only enemy discovered was the dog-whelk, *Purpura lapillus*, which sometimes bores the shell.

Breeding Habits of Chitons.‡—H. Heath gives some notes on these from the Californian coast. In *Ischnochiton mertensii*, *I. cooperi*, *Mopalia mucosa*, and *Katharina tunicata*, egg-laying does not take place until the sperms have diffused into the neighbourhood of the females. *Trachydermon raymondi* carries its eggs (to the number of about 200) in the mantle cavity on each side of the foot until they reach an advanced trochophore stage. While the gills are thus covered and respiration impeded, the proboscis is highly distended with blood, and the lateral protuberances ("Laterallappen") become much enlarged, and both may temporarily assume increased powers of respiration. When the young

* Proc. Acad. Sci. Philadelphia, 1905, pp. 345–61 (2 pls.).
† Amer. Nat., xxxix. (1905) pp. 325–33.
‡ Zool. Anzeig., xxix. (1905) pp. 390–3.

of *T. raymondi* and *Nuttallina thomasi* are kept in favourable conditions as regards abundance of nourishment, they attain sexual maturity within one year.

Land and Fresh-water Shells of the Bahamas.* — W. H. Dall describes a collection of these shells, amongst which are several new forms. In a general way each group of islets, or each island inhabited by land shells has its characteristic forms of pulmonate molluscs. Some few forms are widely distributed, but others, especially *Cepolis* and *Cerion*, are for the most part very local, with a few widely distributed species.

γ. Scaphopoda.

Structure of Dentalium.†—Arcangelo Distaso communicates notes on the minute structure of the foot, the respiratory organs, the osphradium, the reno-pericardial opening, the heart, and the hypobranchial gland of this interesting type.

Anatomy and Histology of Dentalium.‡—Maria Boissevain gives some details on this subject, several of which are here enumerated. The foot is covered with a ciliated epithelium, and upon it unicellular glands are present. On the edge of the mantle are pigment-spots, and on the inner side of its anterior border there is a zone of sensory epithelium. The gut musculature consists of a thin layer of circular fibres. There is a taste sac in the subradular organ. The communication between the sex glands and the kidney must arise anew at every sexual period. In the region where the communication is made, there lie peculiar groups of cells, about the nature of which nothing is known.

δ. Lamellibranchiata.

Growth of Oysters.§—O. C. Glaser has made experiments to ascertain (1) whether normal oysters can be converted into elongated ones by pressure; (2) whether elongated oysters liberated from an oppressive environment will change in shape; and (3) whether the recuperative powers of elongated oysters varies with their age.

His answers, briefly stated, are the following :—The elongated conditions often exhibited by young oysters is due to crowding. But old oysters normally become "razor-blades." The crowded young forms may be said to be in a state of premature old age. When removed from crowded conditions, their growth in width is rapid for a considerable time. The recuperative power varies with age. Young individuals recover much more rapidly than old forms, though these, too, improve to a marked degree.

Derivation of North American Unionidæ.‖—C. A. White discusses the origin and distribution of fresh-water mussels in North America. In particular he brings forward evidence to show that the well-known types

* Smithsonian Misc. Coll., xlvii. (1905) pp. 433–52 (2 pls.).
† Zool. Anzeig., xxix. (1905) pp. 271–8 (6 figs.).
‡ Jena Zeitschr., xxxviii. (1904) pp. 553–72 (3 pls.).
§ Johns Hopkins Univ. Circ., No. 3 (1905) pp. 226–40 (1 pl.).
‖ Smithsonian Misc. Coll., iii. (1905) pp. 75–88 (6 pls.).

of North American Uniones in the fauna of the Mississippi river have descended genetically from North American fossil forms.

Cytology and Artificial Parthenogenesis in Eggs of Mactra.*— K. Kostanecki has carried out experiments with various alkaline salts, and with different degrees of concentration of sea-water, and has been successful in initiating development. His observations included a study of sections of the developmental stages induced as well as the living material. Those eggs which were treated with a solution of potassium chloride approached most nearly in their development to the behaviour of fertilised eggs. The author considers that by a suitable arrangement of the conditions, such as concentration, length of time in the fluid, and so on, a reproduction of the normal results might be achieved. The experiments indicate the lines along which future inquiries should be directed.

Adductor Muscles of Mactra and Pecten.†—F. Marceau has studied the mechanical work done by these muscles. They only do their maximum in a given time when they have to overcome an external resistance (the water) in addition to their action on the ligament. The vitreous, more or less rapidly contracting portion of the muscle, closes the shell; the nacreous, more or less slowly contracting portion, keeps the valves closed.

Structure of the Pearl Oyster.‡—W. A. Herdman gives a full description of the structure of the Ceylon pearl oyster, *Margaritifera vulgaris* Schum, with notes on the habits and functions of the living animal.

Arthropoda.

a. Insecta.

Poison in Bees' Eggs.§—C. Phisalix has shown that in the toad and the viper the specific poisons accumulate in the ova, and has suggested that they play an important part in the phenomena of development and inheritance. He now shows that in bees the ova contain small quantities of poison. It required 475 eggs to furnish enough to poison a sparrow. Phisalix tackles the difficulty that the unfertilised poison-containing egg gives rise to a drone without poison. To allow of the development of a poisonous female the poison "determinants" in the ovum require to be supplemented by something furnished by the spermatozoon or by the accessory male glands.

Habits of Gerydus chinensis.‖—J. Kershaw gives interesting notes regarding some of the habits of this butterfly. The female deposits her eggs upon the branches of the bur-marigold, *Bidens pilosa*. These branches are covered with aphides and ants, which she thrusts aside with a brushing movement of her tail, immediately laying a single egg. The ants do not appear to meddle either with the butterflies or the eggs. The larvæ

* Arch. Mikr. Anat., Bd. 64 (1904) pp. 1–98 (5 pls.).
† Comptes Rendus, cxli. (1905) p. 278.
‡ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 37–76 (9 pls.).
§ Comptes Rendus, cxli. (1905) pp. 275–8.
‖ Trans. Entomol. Soc. Lond. (1905) pp. 1–4 (1 pl.).

feed on the aphides, disposing of them rapidly, then licking and cleaning their appendages just as a mantis does. They pick and choose amongst them, moving their heads up and down over the backs of the insects, evidently smelling them. When not feeding, the larvæ rest amongst the aphides or crawl leisurely about, between or over them, and the aphides do likewise, the larvæ being sometimes covered with them. The eggs of the butterfly, too, are often hidden under a mass of aphides.

Butterfly Destroyers in Southern China.*—J. Kershaw reviews the factors in the elimination of butterflies by other animals as he has observed them in Southern China. The list of foes includes spiders, flies, ants, bugs, centipedes, lizards, and birds. His notes suggest that butterflies which have escaped the sundry and manifold dangers of the egg, larva and pupa stages, have collectively comparatively little to fear in the perfect state.

Notes of Butterflies from India and Ceylon.†—G. B. Longstaff gives an extremely interesting account of a collection of butterflies made by himself during a six months' journey in India and Ceylon. During this time he took nearly 1700 specimens, of which 1500 were butterflies belonging to 204 species. To these are to be added from China, Japan, and Canada, 500 more specimens and 64 additional species of butterflies, to which incidental allusion is made in the paper. All of these which are worth preserving will be placed in the Hope Collection at Oxford. The notes include (1) references to locality; (2) altitude; (3) habitat; (4) habits, such as the sideways attitude or "list" when at rest, of several species; (5) injuries by enemies; (6) scents; (7) seasonal forms. The paper is rich in bionomic data.

Male Genital Apparatus in Bubalidæ.‡—Enoch Zander has made a precise analysis of the male genital apparatus in this family of Microlepidoptera, describing the differences in various species, and correcting the erroneous interpretations given by Hofmann and by Stitz.

Notes on Coleoptera.§—D. Sharp has revised the genus *Criocephalus* with the following results. *C. syriacus* Reitt is made a separate genus, *Cephalocrius*; a second new genus, *Cephalallus*, is established, which is closely allied to both *Megasemum* and *Criocephalus*. The four genera in question form a natural group to be called Criocephalinæ. These should be placed at the beginning of the sub-family Cerambycides, as being one of the most primitive forms of Longicorn Coleoptera. It differs but little from Coleoptera of other families; it lacks all the specialisations that are so remarkable in other divisions of Longicorns, while but little changes would suffice to make it a member of other divisions, either of Cerambycides or of Prionides.

To this paper is added an interesting note on the habits of *Asemum striatum* and *Criocephalus ferus* by F. G. Smith. These burrow in the stems of *Pinus sylvestris*, the former in dead or enfeebled wood, and the latter in large trees that are standing and growing.

* Trans. Entomol. Soc. Lond., 1905, pp. 5–8. † Tom. cit., pp. 61–144.
‡ Zeitschr. wiss. Zool., lxxix. (1905) pp. 308–23 (13 figs.).
§ Trans. Entomol. Soc. Lond., 1905, pp. 145–76 (1 pl.).

Cockchafer-years.*—J. E. V. Boas points out that in Denmark the cockchafer (*Melolontha vulgaris*) lives for four years, and of the four different stocks, which thus live in Denmark, the one appearing as imago the year before leap-year (1887, 1891, etc.) has been for many years the most numerous. The numbers have been so apalling that "great cockchafer years" are remembered as disastrous. Since 1887 there has been diligent collecting, and the author gives full statistics showing how the numbers have waned in a remarkable way. There are no longer "great cockchafer years." As in other cases there has been a progressive dwindling, the cessation of the plague being probably due to a bacterial disease. It is to be feared, however, that there will be a return after a series of years has elapsed. The author's report is interesting biologically as well as economically.

Variations in Hydrophilus piceus.†—Umberto Perazzo has made a careful study of the variations in this water-beetle, and gives a long series of measurements, without, however, as yet drawing any conclusion.

Diptera, etc., of Uganda.‡—E. E. Austen gives a provisional list of the Diptera and other orders of insects, besides two species of ticks, *Amblyomma sp.* and *Ornithodoros moubata* Murray, forwarded by Lieut.-Col. Bruce from Uganda.

May Flies and Midges of New York.§—J. G. Needham gives an account of the Ephemeridæ, K. J. Morton of the Hydroptilidæ, and V. A. Johannsen of the aquatic nematocerous Diptera—the whole forming the third report on aquatic insects published by the New York State Museum, a valuable and finely illustrated piece of systematic descriptive work.

New Chironomid.‖—B. Grassi describes *Mycterotypus bezzii* g. et sp. n., a new Indian Chironomid. The new genus replaces *Centrotypus* Grassi, and is included in Skuse's sub-family Ceratopogonina.

Structure and Life-History of Psychoda sexpunctata.¶—J. A. Dell gives a careful account of this fly, one of the Nemocera, which abounds on the coke-heaps at Leeds Sewage Works. He describes the nervous, alimentary, and respiratory systems of the larva, the features of the pupa, and the general characters of the adult. We select the paragraph which describes the sexual union :—"In copulation the male runs alongside the female, stroking her with his antennæ, while the wings, antennæ, and halteres are thrown into spasmodic vibration. The large forceps is then extended directly backwards, and the abdomen of the male bent round so that the hinder ends of the two bodies are brought into apposition. The forceps then close upon the body of the female, unless they miss, which not infrequently happens, as the male fly is unable to see what he is doing. In such a case the whole manœuvre is repeated.

* Oldenborrernes optræden og udbredelse i Danmark, 1887–1903. Large 4to, Copenhagen, 1904, 24 pp., 5 large maps.

† Atti R. Acad. Sci. Torino, xl. (1905) pp. 1089–1106.

‡ Royal Society's Reports, Sleeping Sickness Commission, No. 5, July 1905, pp. 3–7.

§ Bull. 86, New York State Museum, 1905, pp. 1–331 (37 pls.).

‖ Atti (Rend.) R. Accad. Lincei. xiv. (1905) pp. 114–20 (4 figs.).

¶ Trans. Entomol. Soc. London, 1905, pp. 293–311 (14 figs.).

The males are apparently unable to distinguish which of their companions are females, as they very frequently attempt to copulate with one another. They have often been seen to die while still attached to the female."

Congo Floor-Maggot.*—J. Everett Dutton, J. L. Todd, and Cuthbert Christy report on a blood-sucking Dipterous larva found in the Congo Free State. It lives in the huts of the natives, burrowing by day in the floor, and coming out at night, like a bed-bug, to suck blood. A large brown fly—*Auchmeromyia luteola* F.—often found in the huts, is, perhaps, the imago of the larva reported on.

Culicidæ of Cameroon and Togo.†—K. Grünberg, in view of the great importance of the Diptera in relation to disease in tropical Africa, gives an account of the distribution of various Culicidæ from Cameroon and Togo. The list is made up from material in the Berlin Museum, and consists of twenty-one species, which, though not exhausting the fauna, is probably representative.

Fleas and Disease.‡—C. F. Baker has shown that the fleas of rats in the warmer regions of the earth are close relatives of the flea specific to human beings, and thus far more likely to bite human beings than are the fleas in the colder regions, which are only distantly related to *Pulex irritans*. It is now necessary to know if any of these southern rat-fleas—of which there are a number of species—voluntarily bite human beings. The author refers to the supposed relation of fleas to bubonic plague, and the news that Carrasquilo, of Bogota, has found the bacillus of Hansen in the intestinal canal of fleas.

Ovary of Termites.§—G. Brunelli describes the ovary and the oogenesis in *Termes lucifugus*. The growth of the oocyte is peculiar when compared with that in other insects; it resembles in part what has been described in *Molgula* among Tunicates. The ovary is panoistic without nutritive cells, and this implies that there is a vitellogenous formation on the part of the oocyte itself.

Notes on Larva of a Coreid Bug.‖—N. Annandale describes the egg and early larval stages of a bug, probably *Dalader acuticosta* Amyot et Serv. An interesting note upon a Hymenopterous parasite of the family Chalcididæ, found within the egg-cases of this bug, is given. No apertures, save the extremely minute micropyles, were observable, and consequently it is to be concluded that the eggs of the parasite are of extremely small size.

Peculiar Organ in Phryganids.¶—F. Ris calls attention to a very peculiar and enigmatical structure on the last abdominal segment of the males of *Oecetis notata* and *O. testacea*, which was also observed by MacLachlan. It is an exclusively cuticular structure, with honeycomb-

* Liverpool School Trop. Med. Memoir xiii., 1904, pp. 49–56 (1 pl.). See Biol. Centralbl., xxv. (1905) pp. 431–2.

† Zool. Anzeig., xxix. (1905) pp. 377–90.

‡ Amer. Nat., xxxix. (1905) pp. 507–8. See also Proc. U.S. Nat. Museum, xxvii. (1904).

§ Atti (Rend.) R. Accad. Lincei, xiv. (1905) pp. 121–6 (2 figs.).

‖ Trans. Entomol. Soc. London, 1905, pp. 55–9 (1 pl.).

¶ Viert. Nat. Ges. Zürich, xlix. (1905) pp. 370–4 (1 pl. and 2 figs.).

like hexagonal alveoli open to the surface. There is no evidence that it is an odoriferous or luminiferous organ, and it is certainly not stridulatory.

Habits of Striped Meadow-Cricket.*—Joseph L. Hancock gives an interesting account of the habits of *Oecanthus fasciatus* Fitch. The protective resemblance is exquisite. The shrill notes are not unlike a sparrow's heard at a distance, or the croaking of a frog. In courtship the male uses his modified tegmina as an alluring instrument, and an alluring gland in the centre of the metanotum of the thorax, from which the female obtains a much appreciated "plasmatic drink." The structure of this "loving cup" is described. There is also a singular eversible sacculated structure on the dorsum of the abdomen between the third and fourth tergites, possibly "repugnatorial." The oviposition is carefully described.

Notes on Arboreal Insects.†—A. T. Gillanders has some interesting notes on timber-beetles, e.g. species of *Hylesinus*, *Hylastes*, *Phlœophorus rhododactylus*, *Polygraphus pubescens*, *Trypodendron lineatum*, *Orchestes fagi*. He gives some fine photographs of their burrowing work.

Injurious Insects in Ireland.‡ — G. H. Carpenter reports on a number of injurious insects and other animals observed in Ireland in 1904. He deals with the gout-fly, the mangold-fly, the pea-beetle, the celery-fly, the pear-midge, the willow-bud gall-midge (*Rhabdophaga heterobia* Loew), and other forms. The report also deals with the black-currant mite (*Eriophyes ribis*), and a new Oribatid mite, *Lohmannia insignis*, recently described by A. Berlese, and now recorded for the first time from Britain.

δ. Arachnida.

Geographical Distribution of Scorpions.§—K. Kraepelin discusses this subject. He gives a detailed account of the actual distribution of the several families, and reviews the facts in relation to the six zoogeographical regions of Wallace. One or two of his general conclusions may be given. The scorpion fauna of today has probably arisen from two stocks already distinct in the Silurian epoch, one of which gave rise to recent Buthidæ, and the other to the rest of the families of scorpions. The chief types as they are represented by the present family characteristics have lived for long periods all over the earth, and are all represented even today in the Old and New Worlds. In the New World the older types of the Carboniferous race of scorpions (Chactidæ, Vegovidæ, Bothriuridæ, Diplocentridæ) have been preserved (unequally) more numerously than in the Old World, where their place is chiefly occupied by the greatly developed Scorpionidæ. The Buthidæ stem, which springs from the Silurian scorpions, has been developed almost equally in both hemispheres; in the Eastern as the sub-family Buthinæ, and in the long-separated continents of the Western hemisphere in the two distinct sub-families Tityinæ and Centrurinæ.

* Amer. Nat., xxxix. (1905) pp. 1–11 (3 figs.).
† Trans. Manchester Micr. Soc., 1904, pp. 58–66 (2 pls.).
‡ Econ. Proc. R. Dublin Soc., i. (1905) pp. 281–305 (4 pls. and 6 figs.)
§ Zool. Jahrb. Abt. Syst., xxii. (1905) pp. 321–64.

Poison-Glands of Latrodectus.*—L. Bordas describes the minute structure of the poison-glands in *Lactrodectus* 13-*guttatus*, a common spider in Southern Europe, which is usually much dreaded. He finds that the bite is not at all dangerous to man or larger animals, though it causes paralysis and rapid death in insects. When he tried the effect of the bite on himself, the result was a slight swelling and inflammation, which disappeared in a few days.

North American Spiders.†—Nathan Banks gives a handy synopsis of the families and genera of North American Araneida, to which is prefixed a general account of the external characters of spiders.

Classification of the Tartarides.‡—H. J. Hansen and W. Sörensen have—as the result of the examination of a considerable amount of material obtained from various sources of this tribe of the Pedipalpi—reduced the four genera formerly accepted to one and a sub-genus. They have increased the number of known species from five to sixteen, and of these, fifteen are described in the paper. The genus and sub-genus retained are respectively *Schizomus* and *Trithyreus*.

Structure of Pedipalpi.§—C. Börner gives a monographic account of the Pedipalpi, which includes a large number of new results. The following may be noted :—The proof of the similar segmentation of the carapace in Palpigradæ and Schizonotidæ ; the discovery of a probable vestige of the thirteenth episthosomal segment of scorpions and Merostomata between the ninth and tenth body-segment of Thelyphonidæ ; evidence of homology in the jointing of the second to the sixth prosomal appendages in Pedipalpi and other Arachnids ; the probability of the regeneration of the flagellum in *Kœnenia* and Thelyphonidæ ; the genetic relation between pore-canals and lyriform organs ; the discovery of a very primitive form of the prosomal entosternum in *Trithyreus cambridgei* ; the interpretation of the odoriferous glands of Thelyphonidæ as anal glands ; the discovery of three successive regions in the coxal gland of *Kœnenia* ; the demonstration of coxal gland openings on the inner side of the base of the coxæ of the third appendage in all Pedipalpi ; the discovery of a pair of extrusible ventral sacs in the second pulmonary segment of some Tarantulidæ, which are not true lungs, but comparable to the lung-books of some species of *Kœnenia* ; the demonstration of the heart in *Kœnenia*. But there are many other new points, e.g. as to the nervous and reproductive systems. The monograph is one of great importance, and throws much light on a group of animals which have received relatively little attention.

New Pycnogonid.‖— J. C. C. Loman describes *Pipetta weberi*, g. et sp. n., from deep water in the Banda Sea. The body is slender, distinctly jointed, with long lateral processes separated by large intervals, with a very long, thin, bottle-shaped proboscis, and with a long thin abdomen. The chelifori are absent, the palps are slender, longer than

* Ann. Sci. Nat. (Zool.) i., 9th series, 1905, pp. 147–64 (1 pl. and 4 figs.).
† Amer. Nat., xxxix. (1905) pp. 293–323 (23 figs.).
‡ Arch. Zool., ii. (1905) No. 8, pp. 1–78 (7 pls.).
§ Zoologica, xvii. (1904) heft 42, pp. 1–104 (4 pls and 52 figs.).
‖ Tijdschr. Nederland. Dierk. Ver., viii. (1904) pp. 259–66 (7 figs.).

the proboscis, and 8-jointed; the false legs are weak, 10-jointed, without denticulated spines, with the last four joints strongly curved, and with a very small claw on the tenth joint. The legs are slender, with a strong terminal claw without auxiliary claws. The lateral cæca of the intestine penetrate to the fourth joint of the legs. Eggs are found in the body and its lateral processes, but only in the proximal two joints of the legs. The author also discusses the proboscis of Pycnogonids in general.

Ceylonese Pantopoda.* — G. H. Carpenter describes *Phoxichilus mollis* sp. n. and *Nymphon longicaudatum* sp. n. from Ceylon. It is noted that both these species are remarkably poor in spiny or heavy armature or clothing, as compared with other members of their genera.

ε. Crustacea.

Affinities and Distribution of Cambarus.†—A. E. Ortmann discusses the affinities of the species of *Cambarus*, grouping them under four sub-genera according to the chief types of the sexual organs of the male. The various species are reviewed from the point of view of their distribution over the United States, and here amongst other points are noted the following. Morphologically isolated species occupy isolated stations, e.g. *C. cubensis* in Cuba; *C. shufeldti* in Louisiana; *C. setosus* in Missouri (cave form). Closely allied species occupy neighbouring areas; this is evident in cases where groups of species occupy a certain range, but represent each other in the different parts of this range. More or less closely allied species, occupying the same or nearly the same territory, are generally of different habits, e.g. *C. virilis* prefers running water with stony bottom, while *C. immunis* is a pond and ditch form. Very important drainage changes that have taken place in the southern Appalachian system are clearly indicated by the distribution of crayfishes. Identical or closely allied forms are found in separate systems which formerly were united. This is illustrated by *C. erichsonianus*, *C. extraneus*, etc.

Sperm-receptacle of Cambarus.‡ — E. A. Andrews describes the peculiar "annulus ventralis," or sperm-receptacle, found on the ventral surface of the females of American crayfishes of the genus *Cambarus*, and shows that its use forms so integral a part of the complex sexual habits of the crayfishes that without it the eggs would not be fertilised. It is an elevation of the areolar connective tissue full of blood, on the ventral side beneath the nerve-cord, covered by a peculiar mass of exoskeleton, and inclosing a peculiarly bent trumpet-shaped cavity. It receives the spermatozoa from the male, and from it the spermatozoa pass out when the eggs are liberated. Extirpation of the annulus before laying was followed by the death of the eggs, though they were laid and attached to the female swimmerets as usual. It seems probable that mechanical pressure exerted by the female brings about the discharge of sperms from the receptacle at the time of laying.

* Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 181–4 (1 pl.).
† Proc. Amer. Phil. Soc., xliv. (1905) pp. 91–136 (1 pl.).
‡ Johns Hopkins Univ. Circular, 1905, No. 5, pp. 1–9 (1 pl.).

East African Decapods and Stomatopods.*—H. Lenz reports on a collection made by A. Voeltzkow including 129 species, among which are new species of *Leptodius*, *Gonodactylus*, *Protosquilla*, *Harpilius*, and *Neptunus*; a new genus *Voeltzkowia*, one of the Hexapodinæ; and another new (unnamed) genus belonging to the Grapsidæ.

New Species of River-Crab from Yunnan.†—W. T. Calman describes *Parathelphusa spinescens* sp. n. from the lake at Yunnan. It differs remarkably from any species hitherto described from Asia, and in some characters—e.g. the possession of more than four antero-lateral teeth on the carapace, resembles the African group of species forming the sub-genus *Acanthocephalusa* of Ortmann. It is, however, not necessary to assume any special relationship with the African species.

Abyssal Crabs.‡—H. Coutière discusses young forms of the genus *Caricyphus*, as represented in the Prince of Monaco's collections. It is one of the most remarkable of the Eucyphota, and helps to link the Decapods to the Schizopods and even to the Phyllopods. The affiliation of young forms of *Caricyphus* to adult genera like *Toxeuma* is certain. Many similar young forms have been made into separate genera, in ignorance of the extraordinary metamorphoses. It is probable that *Bentheocaris* and *Procletes* are larvæ of Hoplophoridæ, and that *Kyptocaris*, *Anebocaris*, *Rhomaleocaris*, *Icotopus*, *Hectarthropus* are larvæ of Eucyphota. The abyssal Eucyphota have an unsuspected complexity in their life-history; the contrast between larva and adult is comparable to that between insect-larva and imago.

Epipodites of Eucyphota.§—H. Coutière gives an account of the epipodites of the thoracic limbs, and maintains that they represent a vestigial branchial organ.

Ceylonese Cumacea.‖—W. T. Calman describes nine new species collected off Ceylon by W. A. Herdman and Hornell. No Cumacea have hitherto been recorded from the Indian Ocean. There are two new species of *Eocuma* and four of *Cyclaspis*; the others are *Iphinöe macrobrachius*, *Paradiastylis brachyura*, and *Nannastacus stebbingi*.

Ceylonese Caprellidæ.¶—Paul Mayer reports on *Monoliropus falcimanus* sp. n. and a number of other species (previously recorded).

Ceylonese Amphipods.**—A. O. Walker reports on the rich collection of Amphipods made by W. A. Herdman and Hornell on the coasts of Ceylon. "It is undoubtedly the most important that has ever been brought from a tropical sea." It includes 80 species, of which 36 are new to science. Six new genera are established.

Artemia salina.††—Cesare Artom has made some interesting observations on *Artemia salina* from the brine-pools of Cagliari. It is not a

* Abh. Senckenberg. Nat. Ges., xxvii. (1905) pp. 339–92 (2 pls.).
† Ann. and Mag. Nat. Hist., No. 92 (1905) pp. 155–8.
‡ Comptes Rendus, cxli. (1905) pp. 267–9. § Tom. cit., pp. 64–6.
‖ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 159–80 (5 pls.).
¶ Tom. cit., pp. 223–8 (9 figs.). ** Tom. cit., pp. 229–300 (8 pls.).
†† Zool. Anzeig., xxix. (1905) pp. 284–91 (1 fig.).

distinct species morphologically, but it has some physiological peculiarities. There is a great abundance of males in copulation throughout the whole year, and independently of the degree of concentration. There is predominant viviparity in winter, and oviparity in summer. There is no evidence of parthenogenesis.

Distribution of Terrestrial Isopods Introduced into Australasia.* Charles Chilton communicates some notes on the distribution of *Porcellio scaber*, *P. lævis*, *Metoponorthus pruinosus*, and *Armadillidium vulgare*, which appear to have been introduced into Australasia, most probably by the unconscious action of man.

New Genus of Isopods.†—Harriet Richardson describes, from the Eastern Pacific, an Isopod which does not appear to belong to any of the known families of the order. Although found free, it is probably a parasite, for some of its characters exhibit marked degeneration. All the abdominal appendages have been lost; it is without eyes, and has prehensile legs. The author names it *Colypurus agassizi*, g. et. sp. n., and makes it the type of a new family Colypuridæ.

Sense-Organs of Limnadia lenticularis.‡—M. Nowikoff gives a very full account of the anatomy of this somewhat rare Phyllopod. A note on the sense-organs only may be given. These consist of compound eyes, simple eyes, a parietal organ, which is probably an organ of touch, and which cannot be compared to the frontal organ of *Branchipus*; sense-organs of the first antennæ; sense-bristles of the second antennæ. It was also found that the abdominal bristles, the leg bristles, and the rowing antennæ bristles, are provided with sense-cells; the spines of the abdomen are protective simply. A darkly staining continuation of the sense-cells runs along the axis of the tactile bristles of the leg. The sense-cell complex is spindle-shaped, and lies at the base of the leg.

Annulata.

Commensals in Tubes of Chætopterus.§—H. E. Enders found, out of 99 tubes, 88 with commensals. These included two Annelids of the genus *Nereis*, 176 crabs of the species *Polyonyx macrocheles*, *Pinnixa chætopterana*, *Pinnotheres maculatus*, and one species of the "stone-crab," *Menippe*, all occurring in most cases near the orifices of the U-tube, and advantageously located for securing food. "Whether or not the commensalism is an advantage to *Chætopterus*, it seems to be a decided benefit to the crabs, *Polyonyx* and *Pinnixa*, grown specimens of which are rarely found outside of the tubes. The advantage to the crabs is very clearly marked by their prolonged breeding season—virtually an example of protected industry."

Neurofibrils in Ganglion Cells of Annelids.‖—Agostino Gemelli has used the methods of Golgi, Apáthy, Bethe, Donaggio, Cajal, and a

* Ann. and Mag. Nat. Hist., xvi. (1905) pp. 428–32.
† Bull. Mus. Compar. Zool., xlvi. No. 6 (1905) pp. 105–6 (1 pl.).
‡ Zeitschr. wiss. Zool., lxxviii. (1905) pp. 561–619 (4 pls.).
§ Amer. Nat., xxxix. (1905) pp. 37–40.
‖ Anat. Anzeig., xxvii. (1905) pp. 449–62 (6 figs.).

method of his own, in the demonstration of the neurofibrils in the ganglion-cells of *Nereis*, *Serpula*, *Lumbricus*, and other Annelids.

Central Nervous System of Annelids.*—J. Krawany has investigated this in *Eisenia fœtida*. The ventral cord of each side sends out both right and left "effector axones." The sensory centripetal nerve fibres seem to remain on the same side with the exception of those of the superficial plexus. The interstitial cells unite the succeeding segments of the ventral cord of the same side by means of non-crossing axones, and those of the opposite side through crossing axones. In the very dense neurophil of the supra-œsophageal ganglion there end longitudinal tracts arising from the ventral cord, which probably consist of axones of interstitial cells and perhaps also of fibres from sensory cells which have reached the brain by centripetal paths. Here also are seen the endings of sensory fibres which enter the brain directly from the periphery. The neurophil is further related to the central ganglionic apparatus of the brain, which consists of a very large number of small cortical cells whose fibres cross in a remarkable way before entering the neurophil. The large connecting cells of the brain appear to play a secondary part.

Gall-forming Annelid on Ophiuroid.†—H. Ludwig gives a brief note upon an Annelid which is found within gall-like formations upon the arms of the deep-sea Ophiuroid *Ophioglypha tumulosa*. It is not a *Myzostoma*, but a well developed Polychæte, to which in the meantime the provisional name of *Ophiuricola cynips* may be given.

Modifications of Segmental Organs in Epitokous Polychæts.‡—Louis Fage describes the changes in the segmental organs of a number of Polychæts at the time of the reproductive crisis, contrasting different types. In the Lycoridæ, where the nephridium is highly specialised, it cannot serve as a genital duct, and it degenerates in the epitokous condition. In other cases, e.g. Cirratulidæ and Syllidæ, the simpler nephridium functions as a genital duct.

Pelagic Sipunculid.§—P. Mingazzini describes *Pelagosphæra aloysii* g. et sp. n., a remarkable, spherical, perfectly transparent, pelagic Sipunculid, which will probably require a new family to itself. It was obtained between New Caledonia and Auckland.

Vascular System of Oligochæta.‖—H. Freudweiler has made a study of this in various lower forms, e.g. species of *Fridericia* and other genera of the Enchytræidæ. The paper contains an account of the gut diverticulum and notes on resorption in the Enchytræidæ. The following points in the vascular system have been made out. Pertaining to the gut sinus are spaces between the gut epithelium and the peritoneum. Spaces between the cœlome sacs right and left, above and below the gut, form the dorsal and ventral vessels. On the dorsal vessel there

* Arb. Zool. Inst. Wien, xv. (1905) pp. 281–316 (5 pls.).
† Zool. Anzeig., xxix. (1905) pp. 397–9.
‡ Comptes Rendus, cxli. (1905) pp. 61–4.
§ Atti (Rend.) R. Accad. Lincei, xiv. (1905) pp. 713–20 (2 figs.).
‖ Jenaische Zeitschr. Naturwiss., xxxiii. (1903) pp. 383–422 (2 pls.).

are differentiated single cells, viz., muscular fibres or chloragogen cells, whilst almost all the others leave their basal membrane (peritoneal in origin), perhaps to fulfil further functions as lymph-cells of the cœlome. The ventral vessel and side offshoots are represented only by the basal membrane and isolated cells projecting exteriorly. The amœbocytes of the blood are either lymphocytes which have immigrated from the body cavity, or more probably they have arisen from mesenchyme cells which in the embryo have penetrated between the gut and the cœlomic cavities, and then, attaching themselves to the ventral vessel wall, and increasing in numbers, form in some types a heart-body, whose function is that of a valve and also of a secreting gland.

Epithelial and Connective-Tissue Cells in Hirudo.—E. Holmgren* describes a peculiar relation which exists in *Hirudo* between the epithelial and connective-tissue cells of the œsophagus and cirrus. While the epithelial cells touch each other at the periphery, their main portion is sunk in the connective tissue. F. Blochmann† points out that this has already been noted by him, not only in *Hirudo*, but also in all the divisions of Platyhelminthes. He objects to Holmgren's use of the term "membranellæ," which he applies to the connective-tissue lamellæ between the epithelial cells. Holmgren asserts that "the connective-tissue also sends into the interior of the cells delicate thread-like continuations, and that these under certain circumstances can penetrate the whole cell in order to pass to the other side into the pericellular connective-tissue." Blochmann considers this an error, and that it is a question of three cells cut on a slant; of the two upper ones only the peripheral part is seen, and of the under one only the central portion containing the nucleus.

Nematohelminthes.

Chromosomes of Ascaris.‡—D. Tretjakoff describes various phenomena in *Ascaris*, such as the bending and union of the chromosome ends, and the oblique splitting of obliquely placed chromosomes, which are not in agreement with Boveri's hypothesis of longitudinal splitting. The formation designated by Boveri as a chromatic element appears in both varieties *bivalens* and *univalens* of *Ascaris megalocephala*, only as the final stage of a series of alterations during which each chromatic rod exhibits a certain independence; and consequently the maintenance of the idea of the chromatic element is superfluous.

Gonad Walls in Ascaris megalocephala.§—Adalbert Domaschko describes the histology of the different regions of the gonads of *Ascaris megalocephala*. The epithelium of the whole gonadic tube (except the vagina) is of mesodermal origin, and in spite of the differences in the nature of the cells occurring there, it must be regarded as having been laid down uniformly. The vagina alone is of ectodermal origin.

* Arch. Mikr. Anat., Bd. 65 (1904) pp. 280–97 (2 pls.).
† Anat. Anzeig., xxvi. (1905) pp. 269–71.
‡ Arch. Mikr. Anat., Bd. 65 (1904) pp. 358–82 (1 pl.).
§ Arb. Zool. Inst. Wien, xv. (1905) pp. 275–80 (2 pls.).

New Species of Strongyloides.*—O. v. Linstow, to the three species of this genus already known from many different mammals, adds a fourth. The description given of this form, *Strongyloides fülleborni* sp. n., is derived from specimens reared from fæcal cultures of *Anthropopithecus troglodytes* and *Cynocephalus babuin*, both from Africa. The cultures were made by Dr. Fülleborn in Hamburg.

Platyhelminthes.

Parasites of the Pearl Oyster.†—A. E. Shipley and James Hornell describe seven Entozoa from the pearl oyster; one Cestode, *Tetrarhynchus unionifactor* sp. n.; three Trematodes, *Muttua margaritiferæ* sp. n., *Musalia herdmani*, sp. n., *Aspidogaster margaritiferæ* sp. n.; and three Nematodes, *Ascaris meleagrinæ* sp. n., *Cheiracanthus uncinatus*, and a species of *Oxyuris*. In the trigger or file fishes (*Balistes*), which feed on pearl oysters, numerous Tetrarhynchid cysts were found, but the connection between these and the *Tetrarhynchi* of the pearl oyster is doubtful. In the sea there was found a Planarian-like larva, which resembles the youngest forms found in the pearl oyster.

Histology of Cestodes.‡—W. Minckert has investigated the histology of the epithelium and cuticula in various Cestodes, *Ligula*, *Schistocephalus*, etc. Some of the points elucidated may be quoted. Regarding the "hair-layer" of the cuticle, to the elements of which he gives the name "comidia," he considers it the normal product of a progressive differentiation of the cuticula and therefore of the epithelial cells, and comparable to the cilia layer of Turbellaria. The "comidia" are non-mobile formations of specific morphological rank as characteristic of the Cestodes, if not more so, as the mobile cilia of the Turbellaria. The homogeneous layer shows the following formations: (*a*) trophopores (pore canals of authors) and trophoporules; (*b*) neurophysia with neuropores, viz. the vesicle-like cuticular cavities penetrated by axial nervous substance which is always related to the sense-cells, and giving off delicate canals, the neuropores. Lastly, in the cuticula there is a ground layer, narrow and always more darkly tinged than the homogeneous layer, often appearing granular (*Ligula*, *Schistocephalus*), and situated directly above the place of insertion of the epithelial continuations.

Internal Parasites of Salmon.§—J. R. Tosh gives an annotated list of parasites observed during a season at Berwick-on-Tweed. Of a total of 892 fishes examined, 236, or 26·4 p.c., were infected with tapeworm. Specimens of *Tetrarhynchus grossus* in various stages of degeneration were found resembling the *T. rugosus* of Baird and *T. solidus* of Drummond. These are very likely all referable to *T. grossus*.

Bird Cestodes of Eastern Asia.‖—O. Fuhrmann describes two new species of *Davainea*, one new species of *Anomotænia*, and gives an account of *Cittotænia kuvaria* Shipley, from a new host and a fresh

* Centralbl. Bakt. Parasitenk., xxxviii. (1905) pp. 532–4 (1 pl.).
† Ceylon Pearl Oyster Fisheries Report, Royal Society, Part ii. (1904) pp. 77–106 (4 pls.).
‡ Zool. Anzeig., xxix. (1905) pp. 401–8.
§ Ann. and Mag. Nat. Hist., No. 92 (1905) pp. 115–19 (1 pl.).
‖ Zool. Jahrb. Abt. Syst., xxii. (1905) pp. 303–20 (2 pls.).

region. In view of the limited knowledge regarding Cestodes from regions outside Europe, the details contributed should be of value in furthering the solution of phylogenetic and distributional questions.

New Trematodes.* — W. S. Marshall and N. C. Gilbert describe from the cæcal tubes, stomach, and upper part of intestine of the wide-mouthed black bass, *Micropterus salmoides*, a small Distomid, whose body is entirely covered with minute spines, arranged in two series of diagonal rows, and which they designate *Cæcincola parvulus* g. et sp. n. Another, from the same host, of a peculiar yellowish or pinkish colour, occurring in the mouth, stomach, or on gills, is described as *Leuceruthrus micropteri* g. et sp. n. A third form, *Azygia loossii* sp. n., has been found not only in the stomach of the forenamed host, but also in *Lucius lucius* and *Amia calva*.

Structure and Affinities of Trematodes.†—N. Maclaren gives a detailed account of the anatomy of *Diplectanum æquans* Wagener, and *Nematobothrium molæ* sp. n., the former of which occurs upon the gills of *Labrax lupus*, and the latter in pairs within cysts upon the gills of *Orthagoriscus molæ*. Although *Diplectanum* is much specialised, it possesses many characteristics of Rhabdocœle-like ancestors—e.g. the presence of rhabdites, as in *Temnocephala*, in special regions of the head.

Ceylonese Polyclad Turbellaria.‡—F. F. Laidlaw reports on the Planarians collected by W. A. Herdman off Ceylon, along with three collected by Gardiner. The Ceylonese area seems to be very rich in these forms. Three new genera are established : *Woodworthia* (closely allied to *Idioplana*), *Stylochocestus*, and *Thalamoplana* (closely allied to *Discocelis*).

North American Nemerteans.§—Wesley R. Coe gives a useful synopsis of the species of Nemerteans from the West and North-west coasts of North America ; 87 species (in 21 genera) have thus far been recorded from the West and North-west coasts, while only 19 are known to occur on the East coast of North America. The Nemertean fauna of the Pacific Coast is more abundant and more diversified than in almost any other region of equal extent. The usual diagnostic key is preceded by a general account of the class.

Bryozoa.

Development of Fenestella.‖—E. R. Cumings deals with the development of this Palæozoic Bryozoan, as shown in calcified material (numerous bases of colonies) in which the minutest details of internal structure are preserved with remarkable fidelity. The morphological element of the Bryozoan colony with corresponds to the protoconch of molluscs, or to the protegulum of Brachiopods, is the protœcium or basal disk of the primary individual of the colony. The protœcium is the calcareous or chitinous wall of the kathembryo. In *Fenestella* it is

* Zool. Jahrb. Abt. Syst., xxii. (1905) pp. 477–88 (1 pl.).
† Jenaische Zeitschr. Naturwiss., xxxviii. (1904) pp. 572–618 (3 pls.).
‡ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 127–36 (1 pl.).
§ Amer. Nat., xxxix. (1905) pp. 425–47 (9 figs.).
‖ Amer. Journ. Sci., xx. (1905) pp. 169–77 (3 pls.).

very large, and in every way similar to that of the Cyclostomata. The ancestrula is the tubular superstructure of the primary individual. It is a simple, undifferentiated, tubular zoœcium. The earlier formed zoœcia (nepiastic zoœcia) of the *Fenestella* colony differ markedly in shape and size from later formed (neanastic and ephebastic) zoœcia. In every feature in which they depart from the ephebastic zoœcia of *Fenestella*, they approach the ephebastic zoœcia of Cyclostomata. The terminology of the paper is highly specialised.

Echinoderma.

Species of Holothuria.*—C. L. Edwards has applied biometrical methods to the taxonomic question of the relations of *Holothuria atra* Jäger, *H. floridana* Pourtalès, and *H. mexicana* Ludwig. He has determined the extent of variation, and thus the best (least variable) specific characters. The two last-named species are synonymous, *H. floridana* surviving; but *H. atra* is distinct. The author notes that the number and length of polian vesicles and of stone-canals increase with age; 71 p.c. of the young *H. floridana* have only one polian vesicle, while in the adult the number ranges from 1 to 92. The total number of stone-canals in *H. floridana* ranges, in the young, from 2 to 25; in the adult, from 5 to 149.

Korean Holothurians.†—Hjalmar Östergren describes *Myriotrochus minutus* sp. n., and *Eupyrgus pacificus* sp. n., two new Korean Holothurians of minute size.

Tentacle Reflex in Holothurians.‡—Caswell Grave has studied the contraction of the oral tentacles which takes place when Holothurians (*Cucumaria pulcherrima*) are disturbed, and their invagination within the body. It seems to be at first an instinctive action, but in the absence of constant stimulation and use, in a quiet aquarium, it rapidly loses its efficiency. In the abnormally safe and undisturbed conditions of captivity the reflex seems almost to disappear.

Note on Cucumaria Montagui Fleming.§—A. M. Norman gives convincing reasons for maintaining that *Cucumaria normani* sp. n., recently established by Pace, must be cancelled, in favour of the older *C. montagui* Flem. The question largely turns on the fact that spicules which have six perforations are apparently the young forms of spicules in which the number of perforations is almost invariably four and never six.

Development of an Asterid with Large Yolked Eggs.‖—E. H. Henderson describes the development of a starfish from the Franklin Islands, which shows a close parallelism with the development of *Asterina gibbosa* as described by MacBride. Noteworthy is the large amount of yolk, which forms at least nine-tenths of the whole bulk of the embryo.

* Science, xxi. (1905) pp. 383–4.
† Arch. Zool. Expér., iii. (1905) Notes et Revue, No. 8, pp. cxcii.–cxcix. (1 fig.).
‡ Johns Hopkins Univ. Circular, No. 5 (1905) pp. 24–7.
§ Ann. and Mag. Nat. Hist., No. 93 (1905) pp. 352–9 (1 pl.).
‖ Ann. Nat. Hist., xvi. (1905) pp. 387–92 (2 pls.).

Ceylonese Echinoderms.*—W. A. Herdman and Jane B. Herdman report on Echinoids, Asteroids, and Ophiuroids collected off Ceylon, and F. Jeffrey Bell adds some notes. The report includes 28 sea-urchins, 24 starfishes, and 14 brittle stars, none of which are new. There are some notes of interest as to distribution, habitat, and variation.

Regeneration and Syzygy in Comatulidæ.†—W. Minckert discusses the meaning of syzygy, the relation of individual colour contrasts to regenerative processes, the regeneration of cirri, disk, pinnules, radii, and arms, and the occurrence of autotomy. The syzygia are regarded as predetermined or preformed areas of breakage, and the hypozygalia as bases of regenerative processes. The syzygia, and probably the modified synarthria between the costals and especially between the first and second brachials, are interpreted as special adaptations in connection with the autotomy which is believed to be of not infrequent occurrence in natural conditions.

Ceylonese Crinoids.‡—H. C. Chadwick gives a full description of *Antedon reynaudi*, a little known species, and *A. okelli* sp. n.

Cœlentera.

Spermatogenesis of Hydra.§—E. R. Dowhing finds that the interstitial cells are the immediate progenitors of the spermatogonia. They divide by mytosis, filling the space between the ectoderm cells, which elongate peripherally. There is no migration from other parts of interstitial cells to the region of testis formation. After repeated division to form the testis mass there comes a time when the daughter-cells formed do not grow to the size of the parent interstitial cell, but remain about half its volume. These cells form the first generation of spermatogonia. During this division the chromosomes are reduced to half the somatic number and the spermatogonia of the second generation are transformed with little change to spermatocytes of the first order. Mitosis occurs, forming spermatocytes of the second order. These divide indirectly into spermatids which transform to the spermatozoa. The paper contains a detailed account of the histology of division throughout the entire process, a consideration of the mesoderm and of the relation of the bud to the spermary.

Synonymy of Tubularia larynx.‖—A. Fenchel has made an exhaustive study of this hydroid, and as a result has been led to slump no fewer than 22 species, existing in the literature under the head of synonyms of *Tubularia larynx* Ellis and Solander.

Ceylonese Hydroids.¶—Laura R. Thornely reports on 43 species collected by W. A. Herdman off Ceylon. Thirteen are new, including *Clavactinia gallensis* g. et sp. n., which grows on Gastropod shells.

* Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 137–50 (2 figs.).
† Arch. Natur., lxxi. (1905) pp. 163–244 (1 pl. and 14 figs.).
‡ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 151–8 (1 pl.).
§ Zool. Jahrb. Abt. Anat., xxi. (1905) pp. 379–426 (3 pls.).
‖ Rev. Suisse Zool., xiii. (1905) pp. 507–80 (2 pls.).
¶ Ceylon Pearl Oyster Report, Royal Society, Part ii. (1904) pp. 107–26 (3 pls. and 3 figs.).

It differs from *Hydractinia* in having several verticils of tentacles, and in not having globular clusters of thread-cells in place of tentacles on the blastostyle. Some of the species have a wide distribution over the globe, and there are evident similarities between the Australian and East Indian faunas. The list includes *Plumularia setacea* and *Cuspidella costata*, both British species. The former has been also recorded from North America, Australia, and New Zealand; the latter from North America.

New Type of Siphonogorgid Alcyonarian.* — Jas. J. Simpson describes a beautiful and aparently unique Alcyonarian—one of the Siphonogorginæ—from deep water in the Indian Ocean. He names it *Agaricoides alcocki* g. et sp. n. It is an upright mushroom-shaped colony, with a densely spiculose trunk and a zooid-bearing "pileus." The zooids are introversible within projecting verrucæ—cylindrical extensions of the trunk canals, the upper portions of which are expanded peripherally into octagonal disks containing eight canals, corresponding to the eight compartments formed by the retractor muscles. The anthocodiæ are borne on somewhat slender stalks, the elastic walls of which are continuations of the upper walls of the disks. The tentacles are simply folded over the wide oval disk. The spicules are irregularly echinate, straight and curved spindles, with some approximation to scaphoids, besides single clubs and "hockey-clubs."

Axis of Gorgonidæ.†—Alfred Schneider comes to the following conclusions: (1) The axial epithelium of von Koch is not ectodermic, but is the endoderm lining the axial cavity of the polyp; (2) the formation of the axis is due not to this axial epithelium, but to chalicoblasts and spongioblasts; (3) spongioblasts occur in corals as in sponges; (4) there are transitions between Scleraxonia and Holaxonia, so that this subdivision has little warrant.

Porifera.

Studies on Dendroceratida.‡—E. Topsent prefers the term Dendroceratida instead of Hexaceratida, excludes the family Halisarcidæ, and recognises three families:—

1. Darwinellidæ: *Hexadella*, *Aplysilla*, *Darwinella*, *Dendrilla*, *Megalopastas*.
2. Pleraplysillidæ, fam. n.: *Igernella* g. n., *Pleraplysilla* g. n.
3. Ianthellidæ: *Ianthella* and *Haddonella*.

He gives diagnoses of the genera, and describes a number of new species.

Protozoa.

Notes on Radiolaria.§—Thos. Robinson gives a clear introductory account of the Radiolarians, summarising the most important facts in

* Zool. Anzeig., xxix. (1905) pp. 263–71 (19 figs.).
† Arch. Natur., lxxi. (1905) pp. 105–34 (2 pls.).
‡ Arch. Zool. Expér., iii. (1905) Notes et Revue, No. 8, pp. clxxi.–cxcii. (2 figs.).
§ Trans. Manchester Micr. Soc., 1904, pp. 44–54 (1 pl.).

regard to their structure, life-history, and classification, and showing how a study of the group may be profitably begun.

Fresh-water Protozoa of Connecticut.*—H. W. Conn begins the large task of enumerating and defining the Protozoa of this State, with notes on their habits, life-history, and distribution. So far only the recognised genera are described, but specific diagnoses will follow. There are no fewer than 303 figures.

Craspedotella an Example of Convergence.†—C. A. Kofoid describes *Craspedotella pileolus* g. et sp. n., a new Cystoflagellate, which has a striking resemblance in form to a craspedote medusa. It was taken in mid-Pacific, midway between the Galapagos Islands and Manga Reva, and also off the coast of Southern California. In structural details it has much in common with *Leptodiscus*, but there is a velum at the margin of the bell-cavity. The necessities of flotation and locomotion have brought about independently in the medusa and the Cystoflagellate an external similarity in form, though the inner structural elements are exceedingly diverse in the two—a striking instance of convergence.

Human and Animal Trypanosomiasis.‡—D. Nabarro and E. D. W. Greig give an account of their experiments and observations in Uganda under the Sleeping Sickness Commission. They describe Trypanosomes from cattle, dog, and mule. The experiments conducted in East Africa show that one or more of the varieties of *Glossinæ* found there are capable of conveying the trypanosoma of Sleeping Sickness. Experiments with *Stomoxys* failed to convey any of the three animal trypanosomes (T. IV, V, VI) from infected to healthy animals. The disease, known locally as "Mukebi" amongst the transport oxen in Entebbe, associated with the presence in the peripheral blood, in the earlier stages of the disease of the trypanosome (called T. III) appears to be distinct from Nagana and Surra. From the behaviour of other three animal trypanosomes (termed T. IV, V, VI) in the stomach of *Glossinæ* and *Stomoxys*, it would seem permissible to say that these are three distinct species. From two experiments positive results were obtained indicating that the tsetse flies met with in East Africa are capable of conveying the trypanosoma of sleeping sickness. This is a point of considerable importance, as the belt extends down as far as South Africa, and the fly also runs up the great waterways from the coast.

New Species of Lankesterella.§—H. B. Fantham describes *L. tritonis* sp. n., a new Hæmogregarine from the blood of the newt. He found vermiform trophozoites, some perhaps with micro- and macrogametocytes. The fully-developed trophozoite (Schizont) bends on itself, becomes U-shaped, forms a ring, and gives rise to merozoites. No sporogony was observed. The new form is apparently very like *L. ranarum* (*L. minima* of Hintze), but it is smaller. Indeed, it is apparently the smallest Hæmogregarine yet noted.

* Bull. No. 2, Connecticut State Geol. and Nat. Hist. Survey, 1905, 69 pp., 34 pls.
† Bull. Mus. Comp. Zool. Harvard, xlvi. (1905) pp. 163–6 (2 figs.).
‡ Royal Soc. Reports, No. 5, Sleeping Sickness Commission, July 1905, pp. 8–48 (3 pls.).
§ Zool. Anzeig., xxix. (1905) pp. 257–63 (17 figs.).

Micro-Organisms and Disease.*—S. J. Hickson gives a lucid account of some of the recent advances in the study of micro-organisms associated with disease. He refers to ankylomiasis, the miner's disease due to the Nematode *Ankylostoma duodenale*, whose larvæ penetrate the skin, enter the veins of the skin, pass to the lungs, and thence to the intestine. He goes on to *Monocystis lumbrici*, *Coccidium oviforme*, *C. schubergi*, and thence to the Hæmosporidia and the Trypanosomes.

Trypanosoma duttoni.†—Thiroux discusses this species, found in the blood of mice. It belongs to the type *lewisi*, but *T. lewisi* from the rat cannot be inoculated into the mouse, nor *T. duttoni* into the rat. Other Trypanosomes from rodents, e.g. from squirrel and rabbit and hamster, may be referred to this same type *lewisi*.

* Trans. Manchester Micr. Soc., 1905, pp. 26–34.
† Ann. Inst. Pasteur, xix. (1905) pp. 564–72 (2 pls.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell Contents.

Cytological Studies and Heredity.*—E. Strasburger and three of his pupils have published together a series of papers which are republished under a common title of "Histological Contributions to the Question of Heredity." Strasburger's paper is a general one, and deals with a comparison of typical and allotypic divisions, the two divisions formerly called heterotypic and homotypic being included under the latter term. C. E. Allen has a paper on the exact behaviour of the nuclear material during synopsis in *Lilium canadense*. Miyake follows with observations on the reduction division in the pollen-mother-cells of some Monocotyledons, and there is a final paper by J. B. Overton on similar divisions in some Dicotyledons.

Kinetic Centres in Plants.†—C. Bernards publishes a further paper on the attraction spheres of plants. The work is largely concerned in answering the attacks of Koernicke on the author's earlier paper. He considers it illogical to admit that centrosomes exist in so many groups and yet are absent in Phanerogams. He holds that the bodies he observed are not to be confounded with extra-nuclear nucleoli, and that the existence of a kinetic centre within a zone of dense kinoplasm must be admitted for Angiosperms.

Nuclear Divisions in Endosperm.‡—B. Sypkens has investigated nuclear division chiefly in the parietal layer of the embryo-sac in *Fritillaria*, and in a few other cases of vegetative division, and a summary of his results is given by J. W. Moll. The author's results mainly confirm those of Van Wisselingh, Gregoire, Wygaerts, and Berghs. He finds no evidence for the existence in the nuclear network of two elements, linin and chromatin, and he believes in the individuality of the chromosomes both in the resting and the spireme condition. The author further concludes that the nuclear spindle is entirely formed from the cytoplasm within the nuclear space, but the most important contribution in his paper deals with the relation of the spindle to cell-wall formation, in which he shows that the latter process often takes place without any connection with spindle formation.

* Jahrb. wiss. Bot., xlii. (1905) pp. 1-153 (7 pls.).
† Journ. de Bot., xix. (1905) pp. 80-88, and pp. 89-97 (1 pl.).
‡ Kronikl. Akad. Wetenschapp. Amsterdam, vii. (1905) pp. 412-19.

Cytology of Apospory.*—L. Digby has studied the aposporal development of prothallia in *Nephrodium pseudo-mas* var. *cristata*, which occurs when fronds are pegged down in moist earth. The growth is rapid and prolific; fronds treated during spring and summer showed prothalli with embryos in three weeks. The young plants showed the same character, which seems constant, as no case of sporangium or sorus has appeared on the leaves. The prothallial growth arises from the edge, or sometimes the surface, of the frond, as an outgrowth from the marginal cells and those lying directly beneath the margin of the leaf. The majority have the typical shape except that the cushion is not well-developed; antheridia are frequent, but archegonia were never seen. The prothalli generally bear an embryo, in various stages of growth, situated in the position normally occupied by the cushion. It arises as a direct vegetative outgrowth from the prothallus, and when very young consists of a rounded mass of cells, in which the apical cells of the cotyledon, stem, and root are clearly recognisable. The longitudinal section of an older plant is of a normal type, except for the absence of a foot. The nuclear divisions were studied both in the prothallus and embryo, and the number of chromosomes was found to be approximately the same in the two cases (about 50), thus proving that there is no reduction during the transition of the sporophyte to the gametophyte generation. There was no clear evidence of the nuclear migration which is so characteristic a feature of the apogamous prothallia of *N. pseudo-mas* var. *polydactyla*.

Structure and Development.

Vegetative.

Axillary Scales of Aquatic Monocotyledons.†—R. J. Harvey Gibson compares the ligule of *Selaginella* with the axillary scales which occur in many members of the series Helobieæ of Monocotyledons. He suggests their phylogenetic importance from the point of view that aquatic Monocotyledons may be regarded as modern representatives of the more primitive Angiosperms, and that these in turn may have been genetically related to some ancestral form allied to *Isoëtes*. The scales were examined in 17 species, representing 13 genera belonging to 6 natural orders of Helobieæ.

Reproductive.

Morphological Study of Ulmus americanus.‡—C. H. Shattuck has studied the development of the spores, the process of fertilisation, and the embryology in this species, with a view to a comparison with allied members of the Archichlamydeæ. He finds that the microsporangia are in the mother-cell stage early in February; they probably pass the winter in this stage, forming tetrads at the first breaking of winter weather. The tapetum is formed from the peripheral layer of sporogenous tissue. The pollen-grains leave the tetrad stage in the middle of March, and generally show tube and generative nuclei at this time. The male cells appear by March 23, and the dehiscence of the anther occurs from

* Proc. Roy. Soc., series B, lxxvi. (1905) pp. 463–7.
† Journ. Linn. Soc. (Bot.) xxxvii. (1905) pp. 228–37 (2 pls.).
‡ Bot. Gazette, xl. (1905) pp. 209–222 (3 pls.).

March 25–27. The single megaspore begins to germinate in the middle of February; 8–16 and sometimes more free nuclei are formed. Several pollen-tubes begin to develop from a grain, but only the one which comes in contact with the stigma continues development. The tube generally enters through the micropyle, but sometimes pierces the nucellus at various places, and even passes down the funicle; it may also branch profusely, but apparently only in the case of belated tubes. The male cells leave the grain as soon as the tube is 1 mm. long, remaining close to its tip, and were always found side by side; the tube nucleus does not leave the pollen-grain. Double fertilisation was noted, occurring from March 28–31, the first male cell fusing with the endosperm nucleus. The latter generally divides before the fertilised egg, forming large, multi-nucleolate nuclei. The embryo is of the massive type, the suspensor cell enlarging but little. An antipodal egg is not uncommon. Two embryos are occasionally found in the same sac, and two embryo-sacs are sometimes found in a single nucellus, each with an egg-apparatus. Chalazogamy was not certainly found, but there are indications of its occurrence.

Physiology.

Nutrition and Growth.

Supply of Water to Leaves on a Dead Branch.*—H. H. Dixon concludes that it is unnecessary to attribute to the cells of the stem a special function in the elevation of water, because the leaves above fade when these cells are killed by heat. The fading of the leaves in these cases is probably largely due to the introduction of poisonous or plasmolysing substances into the leaves from the dead cells. Clogging due to the exudation of comparatively impermeable substances into the water-conducting tissue of the plant may also contribute to the fading of the leaves. It is further possible that the application of heat in these experiments may permanently interrupt the water supply by breaking the water-columns, on the continuity of which the water supply depends.

Transpiration of Fouquieria splendens.†—W. A. Cannon gives an account of his study of this plant by the polymeter method (a new method of studying the transpiration of plants *in situ*, which will shortly be described elsewhere). By this means the transpiration of a plant in the field can be studied many times without injury to it, and observations made on the seasonal as well as on the daily variation. The experiments were begun in February, and continued until after the rains of summer were over, during 1904, a season in which the rainfall was smaller than usual, and the conditions during most of the year very severe. *Fouquieria splendens* is the *ocotillo* of the native Mexicans, and one of the most striking desert shrubs, flourishing in habitats which are so dry as to be unfit for many desert plants. During the dry season the branches are naked, but in the rainy ones are well covered with rosettes of small leaves which are borne in the axils of the spines.

* Scientif. Proc. Roy. Dublin Soc., xi. (n.s.) pp. 7–12.
† Bull. Torrey Bot. Club, xxxii. (1905) pp. 397–414 (7 figs. in text).

During droughts photosynthesis is carried on by a chlorophyll-bearing tissue beneath the grey exterior of the stem, and a feeble rate of transpiration can be detected. The rate of transpiration of *Fouquieria* and other shrubs varied directly with the water-supply, increasing as an immediate effect of the rains and decreasing as the time past the rains became greater. Accompanying the increase in rate there was always an increase in the transpiring surface, but a decrease in rate occurred without an immediate and corresponding decrease in the transpiring surface, although in the end this always became less. The least rate of transpiration, when leaves were present, was observed during the dry and cool period in the latter part of March, when 0·22 mgm. per 100 sq. cm. of leaf surface was recorded. The highest rate was at the end of August, near the close of the summer rains, when the temperature was high (8·25 mgm. per 100 sq. cm.). A striking adaptation to desert conditions is the promptness with which *Fouquieria* forms leaves when the water-supply is increased by the rains. The daily periodicity was observed in April. The rate varied in a manner corresponding to variations of the temperature, but not quite the same, and it inversely followed very closely the variation of the relative humidity.

Relation of Transpiration to Growth in Wheat.*—B. E. Livingston, as the result of a series of experiments, concludes that total transpiration of wheat plants grown in various media is as good a criterion for comparing the relative growths in these media as is the weight of the plants. This is explained by the fact that these two criteria vary generally with the weight and area of the leaves. It was evident that, for the types of medium investigated, the amount of transpiration is practically a simple function of the leaf-surface, and that this latter varies quite uniformly with the leaf-weight, which in turn varies with the weight of the entire tops. Thus total transpiration appears to be a measure for the growth of the plant. The nature of the soil or solution in which the roots are grown has little or no influence on those structural and physiological properties of the leaves which control the amount of water lost per unit of leaf-surface. The water loss per unit area of leaves is practically uniform throughout the different treatments; therefore the variations in total transpiration exhibited are due not to any difference in structure or activity of the leaves, but simply to the difference in extent of leaf-surface developed.

Endotropic Mycorhiza.†—I. Gallaud publishes the continuation of his study of endotropic mycorhiza. He takes up the question as to how the hyphæ penetrate the cells of the root. They never enter by the hairs; they envelop the exterior with a fine felt, and here and there penetrate the cells of the host. The growth is always centripetal, and Gallaud does not find that hyphæ grow outwards and spread for the sake of nourishment. The hyphæ never enter secretory cells nor chlorophyll-containing cells, in this differing remarkably from parasitic fungi. The writer next describes the microscopic changes in the root induced by the fungus. He does not find any connection between the

* Bot. Gazette, xl. (1905) pp. 178–95 (25 figs. and diagrams in text).
† Rev. Gén. Bot., xxii. (1905) pp. 313–25.

presence of mycorhiza and the absence of root-hairs. There has been very little modification in the form of the root due to the fungus. In the interior of the root it does not kill the cells; it attacks neither nucleus nor protoplasm, and uses only the non-living nutritive substances. Starch always disappears from the cells that have been penetrated by the mycorhiza.

Growth of Fungi in Artificial Media.* — J. Dauphin cultivated *Mortierella polycephala* on a series of artificial media such as glycerin, alcohol, salicin, etc. Small doses of alcohol did not prevent the growth of chlamydospores and zygospores. The fungus itself does not induce fermentation, unless the alcohol is used as it is formed. A table is given showing the influence of the various substances on the growth of the mycelium and on spore production and spore formation.

Irritabilty.

Circulation of Protoplasm in the Mucorini.† — Alfred Schröter has been studying the influence of external factors on "circulation" in the hyphæ of filamentous fungi. The plants chosen for experiment were *Mucor stolonifer* and *Phycomyces nitens*, which were grown from spores. The streaming of the protoplasm is at first acropetal; if the movement of the plasma had ceased, there was no further hyphal growth. Abundant movement was also noted in the neighbourhood of fruit-formation, where it continues after ceasing in other parts. A diffused light was conducive to active streaming; more direct and intense light acted unfavourably; in the dark the movement stopped entirely. The author gives further an account of effects produced by changes of temperature and atmospheric conditions, and also by mutilation of the plant by cutting the filaments. But chiefly he found that streaming was influenced by change of concentration in the culture media or by change of atmosphere. In a dry air there was active movement, and in regard to the media there was a streaming of the plasma towards introduced osmotic substances, such as sugar solution, saltpetre, etc. The whole movement is forward and backward, something like the streaming of the plasmodium in the myxomycete.

Stimulation of Sterigmatocystis.‡—Elizabeth Latham has studied the response of this fungus to stimulation by chloroform vapour. She gives an account of the various papers already published on the effects produced by chemical substances on fungi and other plants. As a result of her own experiments, she finds that small quantities of the vapour act as a stimulant to growth, while larger quantities are hurtful or fatal. While growth is increased, there is relatively less sugar consumption and less acid production, indicating greater economy in metabolism. Cultures were made in the nutrient solution recommended by Pfeffer, without any sugar constituent; there was no growth, showing that the fungus could make no use of the carbon in the chloroform vapour. She also found that the effect of the vapour increased with the rise of temperature.

* Comptes Rendus, cxli. (1905) pp. 533-4.
† Flora, xcv. (1905) pp. 1-30 (9 figs.).
‡ Bull. Torrey Bot. Club, xxxii. (1905) pp. 337-51.

Effect of Very Low Temperatures on Moist Seeds.*—J. Adams, experimenting with seeds of pea, barley, flax, swede, red clover, meadow fescue, and timothy, finds that whereas 65–96 p.c. of dry seeds germinated after immersion in liquid air for 24 hours, a similar immersion proved fatal to moist seeds. He suggests, as an explanation, a complete rupture of the tissues, causing separation of the cells, or it is conceivable that ice crystals may be formed inside the cell within the protoplasm itself, and the death of the protoplasm may be due to mechanical effects. Whatever be the explanation of what takes place, it seems fairly certain that freezing to death can only occur if the seed contains more than 12 p.c. of moisture. He suggests that while there may be no fatal minimum temperature for dry protoplasm, there is one for moist protoplasm, which lies somewhere above the temperature of liquid air.

Movements of Petals.†—Esther P. Hensel has studied the physical causes which bring about opening and closing movements, periodic or otherwise, of certain flowers. A summary of the work done on the subject since 1686 shows how varied have been the theories as to the cause of the movement of floral leaves. The author was able to control the opening and closing of dandelion heads so far as to close them permanently with lower temperature than normal, and open them when temperature has continued too low, by the application of either dry or moist heat. She also found it possible to close any ephemeral flower before its time by an extra amount of heat, with either dry or moist air; but it was not found possible to open an ephemeral flower by placing the plant in a lower temperature, since this checks growth, and opening here is rather a growth movement than a stimulatory one as in other types. In experimenting with dandelion, *Mentzelia nuda*, *Ipomœa purpurea*, flax, *Mirabilis Jalapa*, and others, light, humidity of the air, and water-content of the soil, were successfully eliminated as possible physical factors likely to cause the opening and closing of flowers by the movement of the petals or ray florets. On the other hand, heat, by its variations during 24 hours, is the direct cause of movement in day- and night-flowering types which bloom for more than one day. In the case of ephemeral flowers which open very early in the morning like *Ipomœa purpurea*, before the temperature has risen to any extent, or those like evening primrose, which open when temperature is falling in the evening, the phenomenon is less easily explained; these, perhaps, react to a smaller variation in temperature than in the case of others.

General.

Revised Classification of Roses.‡—J. G. Baker deals with the genus by dividing it into three groups. In the first group primary species are enumerated; in the second, subspecies and varieties; in the third, the principal hybrids. The primary species are estimated as 69 in number, and they are classified under 11 groups, which may be briefly diagnosed as follows:—I. *Simplicifoliæ*, with simple, exstipulate leaves. II. *Systylæ*, with styles protruded beyond the disk as a united column.

* Scientif. Proc. Roy. Dublin Soc., xi. (n.s.) pp. 1–6.
† University Studies, Nebraska Univ., v. No. 3 (1905) pp. 1–38.
‡ Journ. Linn. Soc. (Bot.) xxxvii. (1905) pp. 70–9.

III. *Banksianæ*, with free, deciduous, linear stipules. IV. *Bracteatæ*, with adnate stipules, having fruits and prickles in infra-stipular pairs. V. *Microphyllæ*, like the last, but the fruit glabrous, with a thick green pericarp. VI. *Cinnamomeæ*, like the last, but the fruits red and glabrous, with a thin pericarp. VII. *Spinosissimæ*, prickles very unequal, never in stipular pairs. VIII. *Gallicanæ*, like the last, but prickles slightly unequal, with leaflets coriaceous and rugose. IX. *Caninæ*, prickles equal, not in stipular pairs, leaves glabrous or slightly pubescent. X. *Villosæ*, like the last, but leaves very hairy. XI. *Rubiginosæ*, like the last, but leaves very glandular beneath.

The geographical distribution briefly is as follows:—Five species are found south of the Tropic of Cancer in elevated situations, two in Abyssinia, one in the Neilgherries, and two in Mexico. There are six geographical regions in the North Temperate Zone, each with a considerable proportion of endemic species. 1. Europe, with 29 species. 2. Northern Asia with China and Japan, 26 species. 3. Western Asia, with 18 species. 4. India, with 9 species. 5. Western North America with the Rocky Mountains, 10 species. 6. Eastern North America, with 6 species.

Mansonieæ, a new Tribe of the Natural Order Sterculiaceæ.*—D. Prain gives an account of a new genus from Burmah, *Mansonia*. Its nearest ally is an African genus, *Triplochiton*, Schum., which has been made the basis of a new natural order Triplochitonaceæ. The order thus proposed is admittedly a member of the cohort Malvales; the peculiar characters on which its claim to ordinal rank is based are to be found in the andrœcium, which consists of a ring of free stamens inserted at the apex of a distinct gynophore, with a whorl of petaloid hypogynous staminodia between the free stamens and the free carpels. The andrœcium of *Mansonia* shares these peculiarities, but *Mansonia* differs generally from *Triplochiton* because the calyx is spathaceous, not regularly 5-lobed; the petals are sessile, not clawed; the stamens are definite, not indefinite in number; and the staminodia are valvate, not contorted-imbricate.

The two genera taken together constitute a very natural group, belonging to the Malvales. There is nothing in the accessory whorls to prevent this group being placed in any of the already recognised orders of that cohort; the gynophore and its relationship to the organs inserted on it, however, exclude Malvaceæ, while the staminodia suggest Sterculiaceæ rather than Tiliaceæ. Finally, the gynæcium makes it practically certain that Sterculiaceæ is the order to which the group belongs. The differential characters relied on by Schumann in proposing his new order do, however, exclude the group from every one of the hitherto recognised tribes of Sterculiaceæ; a new tribe is consequently proposed for the accommodation of the two genera *Triplochiton* and *Mansonia*.

The name of this new tribe, under ordinary circumstances, seeing that it is equivalent to Schumann's order, would have been Triplochitoneæ. There are, however, two genera with the same name—*Triplochiton*. The older of the two, *Triplochiton* Alef., is for the

* Journ. Linn. Soc. (Bot.) xxxvii. (1905) pp. 250-63 (1 pl.).

moment submerged in *Hibiscus*, so that Schumann's genus, though unfortunately named, may retain its present designation. If, however, Alefeld's *Triplochiton* were at any time to be resuscitated, Schumann's *Triplochiton* would automatically disappear, and the continued use of the term Triplochitoneæ would become awkward, if not ambiguous. The opportunity offered by the present adjustment of the status of the group is therefore taken to provide it with a name which neither now nor in future can give rise to any doubt or confusion.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Apospory in Asplenium dimorphum.* — K. Goebel publishes an interesting note on this subject. His observations on a specimen of *A. dimorphum* in the Munich Botanical Garden, lead him to the conclusion that the occurrence of apospory is accidental, and is connected with an abnormality of development. The plant in question showed abnormal divisions of the thallus, and had narrower pinnæ than the other (fertile) ones. The sporangia were much reduced. Prothallia were to be seen with the naked eye on the ends of the pinnæ, and these prothallia were transparent and provided with glandular and other hair structures on the edge, the lower surface, and even between the sexual organs. The details of both the plant and the prothallia are discussed, and the author concludes that apospory and the development of prothallia are dysteleologic—in other words, meaningless malformations. The plant on which the observations were made eventually returned to its normal condition. The author has observed apogamy on *Trichomanes Kraussii*, as well as formation of prothallia from the apex of the first leaf of a germinating plant. On the behaviour of the nuclei in cases of apospory, the author can give no information.

The Rhizophores of Selaginella.†—H. Bruchmann has made a study of the rhizophores of *S. Kraussiana* A. Br., the well-known African species which is so common in greenhouses. He deals shortly with the work of other authors on the subject, and so far disagrees with some of them as to maintain that all species of the genus possess rhizophores, which may be small or large, slightly or much or not at all branched. He describes his results under the following headings: The germinating rhizophores; development and structure of the rhizophores of older plants; phenomena of regeneration in the rhizophores of older plants (including transformation of the rhizophore into leafy shoots and the regeneration of the root-rudiments); the formation of "true" roots by shoots; final remarks. The author points out that the description given by him of these organs in *S. Kraussiana*, must not be considered as descriptive of all species of the genus. *S. Poulteri* alone follows this type, and *S. helvetica*, *S. denticulata*, and *S. Douglasii* resemble it in position and growth of the rhizophores. Another type is represented by

* Flora, xcv. (1905) pp. 239-44 (3 figs. in text).
† Tom. cit. pp. 150-66 (2 pls.).

S. Martensii, which possesses long forked rhizophores with abundant apical growth. Another type again is found in *S. spinulosa*, with which may be classed *S. deflexa*. *S. Lyallii* and *S. lepidophylla* represent other types again. The question is discussed whether the rhizophore is to be regarded as a root or a shoot. The author is satisfied that its nature is that of a shoot. It has apical growth, exogenous origin, and above all it arises not irregularly but always at the place where otherwise a branch would occur on the shoot, and forms with the shoots a system of branching composed of members of equal morphological value, in regular alternate planes, from its first appearance on the germinating plant. In their development, however, the shoots show that they are designed to perform different functions, the one serving as instruments of assimilation, the other as rhizophores. Thus, although the mature rhizophores do not resemble the shoots of their respective species, they are in the author's opinion merely transformed, metamorphosed shoots, modified according to their function.

K. Goebel* also deals with the subject of the rhizophores of *Selaginella*, and agrees with Bruchmann that these organs are morphologically more closely allied to the shoots than to the roots, while partaking of the qualities of both. In this respect they resemble the tubers of the Dioscoreæ. The author states that shoots which develop into resting buds are often formed in *S. grandis* in the place of rhizophores; these shoots can also be produced artificially on species which have been erroneously supposed to have no rhizophores. The formation of rhizophores can also be brought about on aerial shoots which have been cut off from the species which are generally devoid of these organs. The rhizophores are remarkable for their wonderful power of regeneration. The shoots of *S. Martensii*, and probably other species as well, possess the power of rooting at their base, especially when no rhizophores are developed at the forking of the shoot. The "root hairs" of *S. Martensii* are described and figured.

ANONYMOUS.—**The Scouring Rush along the Mississippi.**
[Quotes an extract from Flint's Geography, 1853, about the abundant growth of *Equisetum hyemale*.] *Fern Bulletin*, xiii. (1905) pp. 85–6.

CAMPBELL, D. H.—**Affinities of the genus Equisetum.**
Amer. Nat., xxxix. (1905) pp. 273–85.

CARDIFF, I. D.—**Development of sporangium in Botrychium.**
Bot. Gazette, xxxix. (1905) pp. 340–7 (1 pl.).

CHRIST, H.—**Ueber die australen Polystichum-Arten.** (Concerning the southern species of *Polystichum*.)
[A revision of 9 species gathered in the Antarctic, South America, or New Zealand.] *Arkiv f. Botanik.*, iv. No. 12 (1905) 5 pp.

CHRISTENSEN, C.—**Index Filicum sive Enumeratio omnium generum specierumque Filicum et Hydropteridum ab anno 1753 ad annum 1905 Descriptorum.** (Index of Ferns or enumeration of all the genera and species of Ferns and Fern-allies described between 1753 and 1905.)
[Asplenium—Dryopteris.] Copenhagen; Hagerup, 1905, fasc. iii. pp. 129–92; fasc. iv. pp. 193–256.

CLUTE, W. N.—**A Walking Shield Fern, Polystichum Plaschnickianum.**
[A tropical American plant whose fronds root and bud at the apex.] *Fern Bulletin*, xiii. (1905) pp. 78–79.

* Flora, xcv. (1905) pp. 195–212 (10 figs. in text).

CLUTE, W. N.—**Species and varieties among the Ferns.**
[Treats of the unequal value of species, and considers one by one the primary and more constant characters of ferns, namely, venation, root-stock, position and shape of the fruit-dots, indusium, outline of frond; also the secondary and variable characters, namely, size, colour, texture, vestiture, cutting of the frond.]
Fern Bulletin, xiii. (1905) pp. 65–74.

„ „ **The Fern Allies of North America.**
[Contains fresh descriptions and figures of all the species, and keys to the genera and species.]
New York: The F. A. Stokes Co. (1905) 280 pp., 8 coloured plates and 156 figs.

EATON, A. A.—**Botrychium biternatum Underw.** *Tom. cit.*, p. 87.

GILBERT, B. D.—**An Index to the Fern Bulletin, Vols. I. to X. (1893–1902).**
[It is divided into the following parts, viz. General Index, Index to Species mentioned, List of Contributors, List of Publications Noticed, and List of Illustrations.]
Binghampton, N.Y.: W. N. Clute & Co., 1904, 32 pp.

„ „ **Observations on North American Pteridophytes.**
[Notes on rare or critical ferns.]
Fern Bulletin, xiii. (1905) pp. 74–77.

„ „ **Some Mexican Fernworts.**
[List of 14 species from altitudes of 5000 ft. in Oaxaca and near Orizaba, being partly new records for Mexico.]
Tom. cit., pp. 79–83.

KLUGH, A. B.—**Nephrodium Boottii or Nephrodium spinulosum × cristatum.**
[A question of hybridity.] *Tom. cit.*, p. 86.

LIDFORSS, B.—**Ueber die Chemotaxis der Equisetum spermatozoiden.** (On the chemotaxis of the spermatozoids of *Equisetum*.)
[A preliminary notice of the results obtained by the action of malates and other salts.] *Ber. Deutsch. Bot. Gesell.*, xxiii. (1905) pp. 314–16.

LYON, F.—**Another seed-like characteristic of Selaginella.**
Bot. Gazette, xl. (1905) p. 73.

MAXON, W. R.—**Adenoderris, a valid genus of Ferns.**
[Describes a new species from Guatemala.]
Bot. Gazette, xxxix. (1905) pp. 366–9 (2 figs.).

SCOTT, J. F.—**The Boston Fern and its Varieties.**
Gardening, June 15, 1905; *Fern Bulletin*, xiii. (1905) p. 91.

TERRY, E. H.—**More about the Ferns of Dorset.**
[Supplementary list of Vermont ferns.] *Fern Bulletin*, xiii. (1905) pp. 84–5.

WEISS, F. E. & J. LOMAX.—**The stem and branches of Lepidodendron Selaginoides.**
[Of this species *Sigillaria vascularis* is proved to be a synonym.]
Manchester Memoirs, xlix. (1905) 17, 8 pp. (4 figs.).

Bryophyta.

(By A. GEPP.)

Fegatella conica.*—E. Bolleter publishes a morphological and physiological study of this plant, throwing further light upon some of its structures. It is dioicous, and in the calendar of its development it is shown to begin forming the rudiments of its antheridia in March or April, and the archegonia in April or May. The antheridia becoming ripe in June explode, and fertilisation occurs. Though the elaters and spores are fully developed by October, they remain in the sporogonium

* Beih. Bot. Centralbl., xviii. i. (1905) pp. 326–408 (2 pls. and 16 figs.).

during the winter, and begin to germinate there in March. In April the seta lengthens and the spores are scattered. The structure of the thallus is described in detail—the upper epidermis and spores; the air-chamber, or assimilating layer; the store-house, or conducting tissue, with its mucilage-canals; the lower epidermis, rhizoids, scales, and oil-bodies. Then follow the structure and development of the male and female organs, fertilisation, development of sporogonium, germination of spores, and development of the thallus. Vegetative reproduction consists of the production of adventive shoots and of large gemmæ, and is fostered by moisture and darkness, whereas the production of sexual organs depends upon drier conditions and an excess of illumination.

On the Distribution and Mode of Life of Exormotheca.* — K. Goebel has discovered the existence of this genus of Marchantiaceæ in South Italy, either in Ischia or at Amalfi (he is not certain which). The results of his study of the specimens are described and figured. The thallus is 2–4 mm. broad and is forked, the branches not much exceeding 5 mm. It shows the chimney-like air cavities characteristic of the genus, and is either *E. pustulosa* or a very closely allied species. The antheridia are figured, but the author had no specimen showing archegonia. The thallus has a number of mucilage cells (Schleimzellen) distributed in a peculiar manner. The plant belongs to the tuber-forming liverworts; the tubers arise partly as ventral shoots on the mid-rib (where otherwise no shoots arise), partly as thickenings of the apical portion of the thallus.

Mosses of the Jura.† — C. Meylan has published a catalogue of the mosses of the Jura. He gives a brief account of the work of previous collectors, and indicates the regions which still remain to be explored. He adds a general sketch of the moss-flora of the Jura, and an analysis in which the species are grouped according to their habits and altitudes. In the catalogue proper the species are classified according to Limpricht's *Laubmoose*, and furnished with notes about their habitats and distribution.

ANDERSON, J. P.—**Thalloid Liverworts of Decatur County.**
Iowa Nat., i. (1905) pp. 33, 44.

BLOOMFIELD, E. N.—**Fauna and Flora of Norfolk; Additions to Hepaticæ.**
[List of 19 species, 3 of which are new records for the county.]
Trans. Norfolk and Norwich Nat. Soc., viii. (1905) pp. 148–9.

CARDOT, J. & I. THÉRIOT.—**New or unrecorded Mosses of North America.**
[Four species of *Bryum*.] *Bryologist*, viii. (1905) pp. 95–6.

CHAMBERLAIN, E. B.—**Notes upon Maryland Bryophytes and on two Mosses from Virginia.**
[Notes on 6 mosses and on 2 hepatics from the vicinity of Washington.]
Tom. cit., pp. 77–8.

COKER, W. C.—**Spore distribution in Liverworts.** *Tom. cit.*, p. 93.

DIXON, H. N.—**Nematode Galls on Mosses.**
[Formed by Anguillulæ on *Porotrichum alopecurum* and *Eurhynchium Swartzii*.]
Journ. of Bot., xliii. (1905) pp. 251–2.

* Flora, xcv. (1905) pp. 244–50 (8 figs. in text).
† Bull. Soc. Vaudoise, xli. (1905) pp. 41–96.

Dusén, P.—**Beiträge zur Bryologie der Magellansländer, von Westpatagonien und Südchile.** (Contributions to the bryology of the Magellan region from West Patagonia and South Chile.)
[Continuation. Dicranaceæ.]
Arkiv f. Botanik, iv. No. 1 (1905) p. 45 (11 pls.).

Gilbert, B. D.—**The Advantage of frequent Visits to Moss localities.**
[Notes on the species found in a small swamp near New York.]
Bryologist, viii. (1905) pp. 93–4.

Gustafson, T.—**Bidrag till Hökensåsbygdens Mossflora.** (Contribution to the moss-flora of the Hökensås district.)
[List of 79 hepatics and 255 mosses.]
Arkiv f. Botanik, iv. No. 11 (1905) 32 pp.

Holzinger, J. M.—**Bryum Forsteri sp. n.**
[A Washington moss.] *Bryologist*, viii. (1905) p. 80.

Levier, E.—**Appunti di Briologia Italiana.** (Contributions to the Italian moss-flora.)
[Alphabetical lists of new or rare mosses and hepatics with annotations.]
Bull. Soc. Bot. Ital., 1905, pp. 145–58, 206–16.

Lyon, H. L.—**Polyembryony in Sphagnum.**
Bot. Gazette, xxix. (1905) pp. 365–6 (3 figs.).

Moore, A. C.—**Sporogenesis in Pallavicinia.**
Bot. Gazette, xl. (1905) pp. 81–96 (2 pls.).

Müller, K.—**Ueber die in Baden im Jahre 1904 gesammelten Lebermoose.** (Hepaticæ gathered in Baden during the year 1904.)
[List of 108 species with numerous localities, mostly in previously unsearched districts in the north and south of Baden.]
Beih. Bot. Centralbl., xviii. 2 (1905) pp. 323–46.

Pearson, W. H.—**A New Hepatic from Ireland.**
[*Plagiochila killarniensis*, a new species growing by the Torc Cascade, is described.] *Journ. of Bot.*, xliii. (1905) pp. 281–2 (1 pl.).

Warnstorf, C.—**Vier neue exotische Sphagna.** (Four new exotic Sphagna.)
[Describes new species from Brazil, Porto Rico, and East Africa.]
Allgem. Bot. Zeitschr., xi. (1905) pp. 97–101.

Williams, R. S.—**Notes on Luzon Mosses.**
[Field notes on mosses observed near Manila.]
Bryologist, viii. (1905) pp. 78–80.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Cultivation of Green Algæ.*—A. Artari publishes in tabulated form the results of his experiments as to the effect of concentrated food solutions on the development of certain green algæ. The species experimented on were *Stichococcus bacillaris*, the gonidia of *Xanthoria parietina* and *Scenedesmus caudatus*. *Stichococcus bacillaris* flourished both in very weak and in very strong nutritive solutions, but the relatively strong solutions produced the best results. Sugar solutions affected the shape of the cell according to the strength employed. Relatively strong nutrition was also found most successful for increasing the growth of the gonidia of *Xanthoria parietina*, while *Scenedesmus caudatus* preferred the weaker solutions. The author proposes to publish further details on this subject.

* Jahrb. wiss. Bot., xl. (1904) pp. 593–613 (2 figs. in text).

Sexual Reproduction in Stigeoclonium.*—A. Pascher has studied this subject and made observations on the living plants for the last two years. He finds that in some points his conclusions differ from those of former authors, and he sums up his results as follows: There is a general formation of macrozoospores which have four cilia and a direct germination. The microzoospores are formed like the macrozoospores from the vegetative condition: they are 4-ciliated, and before germination they go through a resting condition of often very short duration. In rare cases they copulate. Bi-ciliated zoospores are formed from the resting spores (akinetæ or palmella condition). These germinate directly, and it has been stated that copulation occurs among them. The formation of bi-ciliated gametæ from vegetative cells has been asserted, but the author considers that sufficient proof is wanting. The aplanospores are modifications of microzoospores.

Brown Colouring Matter in Algæ.†—H. Molisch has made experiments in connection with the brown colouring matter of the Phæophyceæ and Diatoms, and he finds that the substance "phycophäin" does not exist in the living cell at all as has been generally believed, but is formed from a chromogen after death. Phæophyll, on the other hand, exists in the living chromatophore, and is easily converted into common chlorophyll. This fact holds good both in Phæophyceæ and in Diatomaceæ. The author finds that he can convert ordinary chlorophyll by chemical reagents into a brown colouring matter, and this in its turn shortly changes back to alkali-chlorophyll. Comparisons are made between the brown colouring matter of these groups of algæ and that discovered by Schimper in the living chromoplasts of *Neottia nidus-avis*. Leucocyanin has been found in the chromatophores of Phæophyceæ and Diatomaceæ, together with carotin and chlorophyll. The presence of leucocyanin causes the algæ to turn blue-green in a solution of 2 p.c. hydrochloric acid.

Spore Formation in Biddulphia mobiliensis.‡—P. Bergon publishes some new observations on this process as it occurs in *B. mobiliensis*. During quiet days of the winters of 1902–3–4 he noticed a tendency to form internal spores, and he describes the manner of their formation. The nucleus divides and also the cell-contents. Two membranes are formed, the external convex surfaces of which are in contact at their extreme point. Then follows successive division of the nucleus and cell contents into 2, 4, 8, 16, or more, spores. He noticed that the spores of one and the same cell did not all divide in the same manner, and were thus of different sizes and even varied in number. Nevertheless the total number of spores in each daughter-cell was either 32 or 64 when the division was complete. These spores became motile inside the daughter-cells, and this motility was even seen to begin during the division of 16–32 spores. The movement is rotary; the spores have two long cilia and a spheroidal swelling at the free end. The author then describes in detail certain phenomena connected with spore-formation

* Flora, xcv. (1905) pp. 95–107 (2 figs. in text).
† Bot. Zeit., lxiii. (1905) pp. 131–44.
‡ Microgr. Prép., xiii. (1905) fasc. 1, 2.

which he has observed in this Diatom. He believes that he has also recognised sporulation in a specimen of *Chætoceras Weissflogii* Schütt or *C. teres* Cleve; but although he could detect a slow movement it was not distinct, and he could not be sure of the number and form of the flagella. Finally he points out that, though Rabenhorst discovered so early as 1853 the phenomenon of reproduction by zoospores, the confirmation of it has been delayed up to the present day.

Arctic and North Atlantic Marine Algæ.* — F. Börgesen and H. Jónsson have drawn up a series of tables illustrating the distribution of the marine algæ of the Arctic Sea and of the northernmost part of the Atlantic, in order to compare with it the flora of the Faeröes and Iceland. In this list are included species from the coasts of Europe which occur in the N. Atlantic to the north of a line drawn from Lindesnaes in Norway to the boundary between England and Scotland, as well as species from the shores of New England mentioned by Farlow and by Collins. The tables compare the occurrence of species in seventeen different seas and countries in the area treated, and the total reaches 407 Rhodophyceæ and Phæophyceæ, + 24, which belong strictly to America. Then follow various analyses of this general table, under the headings of Arctic group, Sub-Arctic group, Boreal-Arctic group, Cold Boreal group, and Warm Boreal group. The Chlorophyceæ and Cyanophyceæ are given in a supplement, as their distribution is insufficiently known.

Marine Flora of the N. Atlantic, N. Pacific, and Polar Sea.† — H. G. Simmons publishes some most valuable facts on the relation of the marine flora of the above-mentioned seas. It is now more than twenty years since Kjellman's great work on Arctic algæ was published, and the work of the present author brings the list of Arctic species up to date. He deals only with Florideæ and Phæophyceæ, as the synonymy of the other groups is too uncertain to make any comparison profitable. Out of the Kjellman total of 196 species, Simmons cancels 31 as being for one reason or another wrongly included. His own results are presented in the form of tables, which are explained in a most exhaustive and interesting text. In the list of Arctic algæ he includes all species found along the coast from the Kola Peninsula to Behring Strait, along the northern coast of America, in the Arctic-American Archipelago, on the coasts of Greenland, Jan Mayen, Spitzbergen, Beeren Island and Novaja Semlja. Remarks are made and valuable conclusions arrived at with regard to the present distribution of Arctic species outside the Polar circle, and on the influence of the Ice Age on the flora of the seas in question. The distribution of certain genera, including *Laminaria*, *Alaria*, *Lessonia*, etc., is studied in connection with the latter subject, and their migration is explained by geological facts.

Ceramiaceæ of New Zealand.‡ — R. M. Laing has written an account of the Ceramiaceæ of New Zealand. The generic descriptions

* Botany of the Faeröes, Appendix, xxviii. pp.
† Beih. Bot. Centralbl., xix. (1905) pp. 149–94.
‡ Trans. New Zealand Inst. xxxvii. (1904) pp. 384–408 (8 pls.).

are largely drawn from Engler and Prantl's Pflanzenfamilien, and the descriptions of some of the species are based on J. G. Agardh's Epicrisis. But many other species are here freshly described from specimens in the author's own herbarium. A key to the New Zealand genera is given, and these are fourteen in number. Both the generic and specific diagnoses which follow are full of detail, and are further supplemented by critical remarks. One new species is described, *Spongoclonium pastorale*, from the Otago Peninsula. The paper is illustrated by eight plates.

Finland Algæ.*—K. H. Enwald has studied the Chroococcaceæ of Finland, and enumerates in his paper thirty species, among which he describes and figures a new form, *stipitata*, of *C. macrococcus* Rabenh.

K. M. Levander contributes some information on the Rhizosoleniæ of the same country. He had in a previous paper noted the occurrence of *Attheya Zachariasii* Brun., and *Rhizosolenia longiseta* Zach., in Finland plankton; in the present paper he gives notes on the distribution of the Rhizosoleniæ in Finland waters, together with figures and observations on *R. longiseta* Zach., *R. eriensis* H. L. Smith, *R. minima*, Levand. (= *R. gracilis* H. L. Sm.) and *Attheya Zachariasii*.

The Algæ of Lower Austria.†—A. Hansgirg publishes a preliminary paper on this subject, which he is intending to elaborate into an exhaustive book. The present paper includes only the results of his studies during 1903 and 1904, as his work previous to those years has been already published. Records of species collected by other botanists in Lower Austria are also given, as well as lists of places examined by them and himself. The physical and geological character of the region is discussed with relation to the algæ. The hydrophilous and aerophilous algæ are the most developed. The number of species treated in the present paper is 603, among which are 15 new forms and varieties, and 3 new species, one representing a new genus of Myxophyceæ. A comparative table is given of the algæ of Lower Austria, Upper Austria, and Bohemia.

The Algæ of Germany.‡—W. Migula has published the first four parts of his volume on the algæ in Thomé's "Flora of Germany." These parts consist of the Schizophyceæ, with Cyanophyceæ, and include forty genera. At the beginning of the volume the author treats of the general characteristics of algæ, as well as methods of collecting and determining them. Then follows the systematic part, in which each order is described, a synopsis of genera is given, and finally, a short but complete diagnosis of each species. Many are figured in colour.

Algæ of the Weser District.§—J. Suhr concludes his list of the freshwater algæ of the eastern mountainous district of the Weser, and adds some general remarks on the flora as a whole. Of the 393 species and

* Medd. Soc. Fauna Flora Fennica, xxx. (1903–4) pp. 112–17 and 149–55 (1 pl.).
† Beih. Bot. Centralbl., xviii. (1905) pp. 417–522.
‡ Thomé's Flora v. Deutschland, v. parts 11–21 (1904–5) pp. 1–112 (20 pls.).
§ Hedwigia, xliv. (1905) pp. 289–300.

50 varieties recorded, 3 species and 2 varieties are new to Europe, and 21 species and 4 varieties are in addition to these new to Germany. As regards the distribution, the author finds that the rivers are poor in Cyanophyceæ and in green algæ. *Cladophora glomerata* is, however, widely distributed. Diatoms are more common in the rivers, especially species which are either in chains or have a common envelope. The richest localities are the fish-ponds in the forest region; here are Desmids in plenty, as also in the peat moors. Finally a comparison is drawn between the flora of this district and that of the Lüneberger Heide, which was worked out by Max Schmidt. Among other points of interest the author points out that *Batrachospermum moniliforme* occurs in the Weser district only in running brooks, whereas on the Lüneberger Heide it is only found in stagnant water. He also draws attention to the rarity of *Bulbochæte* in the region he has examined; the only species which could be named was found in a fish-pond at the Forsthaus Lakenhaus and nowhere else. A register of the species recorded in this list completes the paper.

Desmids from Victoria.*—A. D. Hardy continues his study of the Desmids of Victoria, and publishes a list of 49 species, as well as some varieties recorded from this district. Three new species and 8 varieties of G. S. West are here described in English, with information regarding the distinguishing characters. A plate, drawn by the author, shows the new forms of *Micrasterias*.

G. S. West † describes the three new species and eight new varieties of Desmids mentioned above, collected by A. D. Hardy, of Melbourne. The novelties are mostly plankton forms. The three species are: *Pleurotænium mamillatum*, *Micrasterias Hardyi*, and *Cosmarium Hardyi*.

Marine Phytoplankton.‡—E. Lemmermann publishes his third part of this paper, containing a list of hitherto known marine phytoplankton. He gathers his records from various papers and works not easily accessible to many students, and in the case of newly described organisms he gives a short description of his own, drawn from the original diagnoses and figures, as an assistance to workers. He points out that he differs from some authors in his limitation of certain species, as for instance *Ceratium tripos*, and many of the Peridineæ and Flagellatæ. However, his views on these points are withheld for the present, as tending to produce confusion in a list such as the one here published. Localities are given for each species recorded. A list of bibliography includes 50 publications by various authors, and is followed by a final note on a very recent paper by C. Lohmann. In that paper the author states that certain species described as *Xanthidium* are merely crabs' eggs, and that *Hexasterias problematica* Cleve is also an animal egg. Lohmann divides the Pterospermaceæ into 4 genera: *Pterosperma* Pouchet, *Pterocystis* Lohmann, *Pterosphæra* (Joerg.) Lohmann, and *Pterococcus* Lohmann.

* Victorian Naturalist, xxii. (1905) pp. 62–73 (1 pl.).
† Journ. of Bot., xliii. (1905) pp. 252–4.
‡ Beih. Bot. Centralbl., xix. (1905) pp. 1–74.

ADJAROFF, M.—**Recherches expérimentales sur la physiologie de quelques Algues vertes.** (Experimental researches on the physiology of certain green algæ.)
Inst. Bot. Univ. Genève, vi. (1905) 104 pp.

ALLEN, C. E.—**Die Keimung der Zygote bei Coleochæte.** (Germination of the Zygote in *Coleochæte*.
[A cytologic study.] *Ber. Deutsch. Bot. Gesell.*, xxiii. (1905) pp. 285–92 (1 pl.).

ANDRES, A.—**Il fango delle terme di Bormio.** (The mud of the warm springs of Bormio.) *Rend. Ist. Lomb.*, 2nd ser. xxxvii. (1904) pp. 723–33, 851–63.

BEVAN, D. W.—**Seaweeds.** *Knowledge and Sci. News*, ii. (1905) pp. 202–3, figs.

BILLARD, G., ET CH. BRUYANT.—**Sur le rôle des algues dans l'épuration des eaux.** (On the rôle of algæ in the purification of water.)
Compt. Rend. Soc. Biol., lviii. (1905) pp. 302–4.

BOUGON.—**Les Algues d'eau douce. Famille des Hydrodictyées.** (Fresh-water algæ. Family of Hydrodictyeæ.) *Microgr. Préparat.*, xiii. (1905) pp. 75–82.

BREHM, V. — **Das Süsswasserplankton. Biologische Ergebnisse, Methoden und Ziele der Planktonforschung.** (Fresh-water plankton. Biological facts, methods, and objects of plankton investigation.)
[A comprehensive study of the subject, dealing especially with zooplankton.]
Programm der k. k. Staatsrealschule in Elbogen in Böhmen, 1905, pp. 3–32.

BREHM, V., UND E. ZEDERBAUER.—**Beiträge zur Planktonuntersuchung Alpiner Seen. III.** (Contributions to the investigation of the plankton of Alpine lakes. III.)
Verh. k.k. Zool. Bot. Ges. Wien, lv. (1905) pp. 222–40.

CHALON, J.—**Note sur une forme très réduite du Fucus limitaneus Mont.** (Note on a very reduced form of *F. limitaneus*.)
Bull. Soc. Roy. Bot. Belgique, xlii. (1904–5) pp. 93–4.

CLEVE, P. T.—**On the Plankton from the Swedish coast stations, Måsekär and Väderöbod, collected during August 1902 to July 1903, and on the Baltic current.** *Svensk. Hydrogr. Biol. Komm. Skrift*, ii. (1905) 9 pp. (text-diag. and 1 diag. map).

„ „ **Report on the Plankton of the Baltic current, collected from August 1903 to July 1904 at the Swedish coast stations Måsekär and Väderöbod.** *Tom. cit.*, 6 pp. (with text-diags.).

COMÈRE, J.—**De l'influence de la composition chimique du milieu sur la végétation de quelques Algues Chlorophycées.** (On the influence of the chemical composition of the medium on the vegetation of certain Chlorophyceæ.) *Bull. Soc. Bot. France*, lii. (1905) pp. 226–241.

„ „ **De l'utilité des algues dans l'élevage et l'alimentation des Poissons à propos de la florule de l'Etang de la Pujade.** (On the utility of algæ in the rearing and feeding of fish, in connection with the flora of the Pujade lake.)
Bull. Soc. Hist. Nat. Toulouse, xxxvii. (1904) pp. 61–8.

FOÀ, A.—**Ricerche intorno a due specie di Flagellati parassiti.** (Researches on two species of parasitic Flagellatæ.) *Atti Acad. Linc. Rend.*, xiii. (1904) pp. 121–30 (fig.).

FUCHS, TH.—**Ueber die Natur von Xanthidium Ehrenberg.** (On the nature of *Xanthidium*.) *Centralbl. Min. Geol. u. Palæontol.*, 1905, pp. 340–2.

GRASSI, B., & A. FOÀ.—**Ricerche sulla riproduzione dei Flagellati. I. Processo di divisione.** (Researches on the reproduction of the Flagellata. I. Process of division.) *Atti Acad. Linc. Rend.*, xiii. (1904) pp. 241–53 (fig.).

HALLAS, E.—**Nye arter af Œdogonium fra Danmark.** (New species of *Œdogonium* from Denmark.) *Bot. Tidsskr.*, xxvi. (1905) pp. 397–410 (figs.).

HOWE, M. A.—**Report on a trip to Europe.**
[Includes studies of marine algæ.] *Journ. New York Bot. Garden*, v. (1904) pp. 217–22.

JACKSON, D. D.—**Movements of Diatoms and other Microscopic Plants.**
Amer. Nat., xxxix. (1905) pp. 287–91.

JÖRGENSEN, E.—**Diatoms in bottom samples from Lofoten and Vesteraalen, in O. Nordgaard: Hydrographical and Biological Investigations in Norwegian Fjords.** *Bergens Mus. Skrift*, 1905, pp. 195–225.

„ „ **Protist-Plankton in O. Nordgaard: Hydrographical and Biological Investigations in Norwegian Fjords.**
Tom. cit., pp. 49–113, 146–51 (3 pls.).

LARGAIOLLI, V.—**Le Diatomee del Trentino. I. Il Fiume Noce.** (The diatoms of Trentino. I. The river Noce.)
Atti Acc. Sci. Ven. trent. istr., Cl. i. ann. ii. (1905) p. 3–10.

„ „ **Le Diatomee del Trentino. XVIII. Lago di Cavedine (Bacino del Sarca.** (The diatoms of Trentino. XVIII. Lake of Cavedine, in the Sarca Valley.)

„ „ **Le diatomee del Trentino. XIX.–XX. Laghi di Malghetto e di Tovel.** (Lakes of Malghetto and Tovel.)
Tridentum, ix. (1904) p. 7; x. (1905) p. 7;
Notarisia, 1905, pp. 68, 106.

LAUBY, A.—**Sur le niveau diatomifère du ravin des Egravats près le Mont Dore, Puys-de-Dome.** (On the diatomaceous stratum in the ravine of Egravats, near Mont Dore.) *Compt. Rend.*, cxl. (1905) pp. 268–9.

LEMMERMANN, E.—**Beiträge zur Kenntniss der Planktonalgen. XX. Phytoplankton aus Schlesien. XXI. Das Phytoplankton sächsischer Teiche.** (Contributions to a knowledge of plankton algæ. XX. Phytoplankton from Silesia. XXI. The phytoplankton of ponds in Saxony.)
Forsch. Ber. Biol. Stat. Plön, xii. (1905) pp. 154–68.

LIFE, A. C.—**Vegetative Structure of Mesogloia.**
Ann. Rep. Missouri Bot. Gard., xvi. (1905) pp. 157–60 (1 pl.).

MERESCHKOWSKY, C.—**Ueber natur und Ursprung der Chromatophoren im Pflanzenreiche.** (On the nature and origin of chromatophores in the plant world.)
Biol. Centralbl., xxv. (1905) pp. 593–604.

MEYER, E.—**Beiträge zur Biologie du Lac de Bret, mit specieller Berücksichtigung des Phytoplanktons.** (Contributions to the biology of Lake Bret, with special regard to the phytoplankton.) Lausanne, 1904, viii. and 52 pp., 5 tables, 1 fig.

MIEHE, H.—**Wachstum, Regeneration und Polarität isolierter Zellen.** (Growth, regeneration, and polarity of isolated cells.)
Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 257–64 (1 pl.).

MIQUEL, P.—**Du noyau chez les Diatomées.** (On the nucleus of Diatoms.)
Microgr. Prép., xiii. (1905) pp. 83–90.

MONTI, R.—**Physiobiologische Beobachtungen an den Alpenseen zwischen dem Vigezzo und dem Onsernonethal.** (Physio-biological observations on the Alpine lakes between the Vigezzo and the Onsernone valleys.)
[Deals principally with the fauna of the lakes, but at the end of the paper is a tabulated list of organisms found in four lakes; this includes 72 Algæ and seven Flagellatæ.] *Forsch. Ber. Biol. Stat. Plön*, xii. (1905) pp. 63–7 (7 figs.).

MURRAY, G.—**On a new Rhabdosphere.**
[A short description of a new species, *R. Blackmaniana*, the characteristics of which are its small size, 10 μ, and its acute short spinous processes. It was collected on the outward voyage of the *Discovery*, in lat. 28° 25′ S., long. 23° 56′ W. The figure is diagrammatic.]
Proc. Roy. Soc., lxxvi. series B, 1905, pp. 243–4.

PASCHER, A. A.—**Kleine Beiträge zur Kenntniss unserer Süsswasseralgen.** (Small contributions to a knowledge of our fresh-water algæ.) *Lotos*, No. 7 (1904) fig.

PAVILLARD, J.—**Recherches sur la flore pélagique (phytoplankton) de l'étang de Thau.** (Researches on the pelagic flora of the lake of Thau.)
Trav. Inst. Bot. Univ. Montpellier et Stat. Zool. Cette, sér. mixte, Mem., No. 2 (1905) 116 pp., 1 map, 3 pls.

PROWAZEK, S.—**Die Entwickelung von Herpetomonas einem mit den Trypanosomen verwandten Flagellaten.** (The development of *Herpetomonas*, a flagellatum allied to the Trypanosomes.)
[A preliminary note.] *Arb. k. Gesundh.*, xx. (1904) pp. 440–52.

REINBOLD, TH.—**Einige neue Chlorophyceen aus dem Ind. Ocean (Niederl. Indien), gesammelt von A. Weber van Bosse, bestimmt von Th. Reinbold-Itzehoe.** (Some new Chlorophyceæ from the Indian Ocean (Dutch East Indies), collected by A. Weber van Bosse, determined by Th. Rheinbold, of Itzehoe.)
[Diagnoses of four new species of *Chladophora*, one of *Cladophoropsis*, and two of *Boodlea*, brought home by Madame Weber van Bosse in the 'Siboga.']
Nuov. Notar., xvi. (1905) pp. 145–9.

SCHNEIDER, A.—**Chroolepus aureus a lichen.**
[Describes how this orange-red alga, now usually placed in the genus *Trentepohlia*, is commonly found with its filaments closely covered with a delicate network of spirally-wound hyphæ of a minute fungus.]
Bull. Torrey Bot. Club, xxxii. (1905) pp. 431–4 (1 pl.).

SETCHELL, W. A.—**Limu.** (Algæ for eating or ceremonial use of the Hawaiians.)
Univ. California Publications, 1905, 23 pp.

SILVENIUS, A. J.—**Kolme suomelle uutta sinilevää.** (Three Cyanophyceæ new to Finland.) *Medd. Soc. Fauna et Flora Fennica*, 1905, heft 30.

" " **Zur Kenntniss der Verbreitung finnischer Chlorophyceen und Cyanophyceen.** (Contributions to our knowledge of the distribution of Chlorophyceæ and Cyanophyceæ in Finland.)
Tom. cit., heft 29.

SUNDVICK, E. E.—**Im brom och jodhalten i Östersjöns alger.** (On the bromide and iodine contents of the Östersjö algæ.) *Tom. cit.*, heft 30.

TERRY, W. A.—**Sur un étrange mode de développement chez le genre Surirella.** (On a strange mode of development in the genus *Surirella*.)
Microgr. Prép., xiii. (1905) pp. 57–60 (figs. 1–6).

URSPRUNG, A.—**Eine optische Erscheinung an Coleochæte.** (An optical appearance in *Coleochæte*.)
[The author finds that under certain conditions of light a dark cross is seen on the disk of this alga. If the light falls vertically on the disk, no cross is to be seen; if it falls at an angle, the cross is visible. The result of experiments in the variation of the angle at which the light strikes the disk and the eye respectively is described.]
Ber. Deutsch. Bot. Gesell., xxiii. (1905) pp. 236–9 (1 pl.).

VAN HEURCK, H.—**Note sur le Cocconeis danica Flögel.** (Notes on *C. danica*.)
Microgr. Prép., xiii. (1905) p. 83 (2 figs.).

VOGLER, P.—**Bisherige Resultate variations statistischer Untersuchungen an Planktondiatomaceen.** (Results hitherto obtained by investigation of plankton diatoms with regard to the statistics of variation.)
[Three works are dealt with—those of Schröter and Vogler, Lozeron, and Bachmann.] *Forsch. Ber. Biol. Stat. Plön*, xii. (1905) pp. 90–101 (2 pls., 8 figs.).

WATTAM, W. E. L.—**Plant Life of the Seashore.**
Nature Study, xiv. (1905) pp. 23–7 (1 fig.).

ZACHARIAS, O.—**Archiv für Hydrobiologie und Planktonkunde. Neue Folge der Forschungsberichte aus der biologischen Station zu Plön.** (Records of hydrobiology and plankton study. New series of research reports from the Plön biological station.)
Stuttgart, 1905.

" " **Rhizosolenia curvata, eine neue marine Planktondiatomee.** (*R. curvata*, a new marine plankton Diatom.)
Arch. Hydrobiol. u. Planktonk., i. (1905).

Fungi.

(By A. Lorrain Smith, F.L.S.)

Two Conidia-bearing Fungi.*—A. F. Blakeslee has succeeded by his method of cultivating different strains of Mucors in close proximity, in inducing the development of zygospores in many forms in which they were rare or altogether unknown. He applied the same method to *Cunninghamella echinulata*, a conidial fungus that had been tentatively placed in the Mucorini by Thaxter. The production of zygospores decided the systematic relationships and justified the classification proposed. He also describes a new genus, *Thamnocephalis*, probably also one of the Mucorini; it bears a "bushy crown of branched fertile hyphæ terminated by sterile hyphæ." The spores are borne on spherical heads, not unlike *Cunninghamella*.

Disease of Haricot Beans.†—L. Petri found that the fungal attack was due to *Sclerotinia Libertiana*, and was confined to the pods. The fungus causes alteration and distortion of the tissues affected. The author does not think that the germinating ascospore could attack a healthy vegetable, but probably it lives first on any plant remains, such as withered petals, etc., that may be adhering to the beans, and the fungus is thus enabled to get a start, and later to attack the living plant.

Witches' Broom on Pear Trees.‡—F. Muth describes a case of this disease on a wild pear. The "brooms" were unusually large, reaching a height of 2 metres, and when present in large numbers they killed the tree. The leaves borne on the "broom" were smaller and paler than normal leaves, and flowers were less freely produced. Mycelium was found in the branches, but no fruit form was seen. Another disease of pear-trees resulting in abnormal growths, splitting and canker formation was examined, but no fungal fruit was found.

Botrytis Disease of Tulips and Lily of the Valley.§—H. Klebahn finds two kinds of sclerotia in the diseased tulips. There is a small form which is accompanied by *Botrytis*. Plants infected by this form produced *Botrytis parasitica* on the leaves. It does not seriously injure the plants. The second form, which he calls *Sclerotium tuliparum*, is larger, and develops on the diseased bulbs and in the adjacent soil. No other fungus form was found connected with these larger sclerotia, merely mycelium, and again sclerotia. Klebahn also describes a disease of lily of the valley due to *Botrytis cinerea*, and he gives an account of infection experiments with forms of *Botrytis*, which indicated some degree of specialisation in the fungus.

Biology of Entomophytes.||—Marcel Mirande publishes a study of the fungi that live on insects. By chemical tests he establishes the pre-

* Bot. Gazette, xl. (1905) pp. 161–70 (1 pl.).

† Rend. R. Accad. Lincei Roma, Nov. 1904, pp. 1–4. See also Bot. Centralbl., xcix. (1905) p. 67.

‡ Naturwiss. Land. Forstw., iii. (1905) pp. 64–76 (13 figs.). See also Bot. Centralbl., xcix. (1905) p. 194.

§ Jahrb. Hamb. Wiss. Anst., xxii. (1904) Beiheft 3. See also Bot. Centralbl., xcix. (1905) pp. 138–9.

|| Rev. Gén. Bot., xvii. (1905) pp. 304–12.

sence of glucose in the chitinous covering of the insect, located at the place of insertion of the muscles, or spread over the whole surface. He finds in the existence of this sugar, a reason why so many fungi grow readily on insects: Saprolegnieæ, Laboulbeniaceæ, and several Hyphomycetes. Where a sclerotium is formed in the body of the insect, as in *Cordyceps*, the outer chitinous covering must play an important part in nourishing the ascus form of fruit.

Biology of Ergot.*—R. Stäger gives the results of his infection experiments with *Claviceps*. The forms that grow on *Brachypodium silvaticum* also infect *Milium effusum*, but only the *Sphacelia* condition was developed. In tracing the life-history of the fungus, he found that the infection of the flower of *Milium effusum* is caused by the Ascospores of *Claviceps Brachypodii*; the conidia formed on *Milium* then infect *Brachypodium silvaticum*, in the flower of which the *Sclerotium* is formed. It was also possible to produce the *Sphacelia* stage on *Poa pratensis* and *P. trivialis*.

Phyllactinia Corylea.†—P. Voglino publishes a full account of the morphology of this fungus. He describes its development in the leaf and its action on the leaf tissue. Although it is usually superficial, some of the hyphæ penetrate through the stomata and cause a discoloration of the host-cells. He draws special attention to the needle-like appendages of the perithecium and also to the attaching filaments, hyphæ that rise from the base of the perithecium and branch out into a pencil-like head of elongate cells all equal in length. He proposes to call them epipectic hyphæ (*ife epipecteche*); they serve to keep the fruits attached to the leaf during the winter, and so secure early infection of the host-plant in spring. Voglino tried infection experiments with the ascospores from one host to another, without result. There is, probably, specialisation in this genus similar to that which has been proved in other members of the Erysiphaceæ.

Morphology and Cytology of Yeasts.‡—A. Guilliermond gives a description of the development of the yeast-cell, especially of sporulation and conjugation. Caryogamy is wanting at the origin of the ascus in *Saccharomyces*; conjugation takes place before sporulation in *Zygosaccharomyces* and *Schizosaccharomyces*. In the latter apogamy has also been noted. In *Saccharomyces Ludwigii* two spores fuse before germination, and an ascus has sometimes been formed as the result of this conjugation. The author considers that the Schizosaccharomycetes are connected with the Saccharomycetes by the genus *Saccharomycodes*. Their connection with the Bacteria is problematic.

Vacuoles in Yeast-Cells.§—An examination of yeast-cells has led J. J. Van Hest to believe that they do not contain vacuoles, but that the appearance so described is due to flattened portions of the cell-wall.‖

* Centralbl. Bakt., xiv. (1905) pp. 25–32. See also Bot. Zeit., lxiii. (1905) p. 216.
† Nuovo Giorn. Bot. Ital., xii. (1905) pp. 313–27 (8 figs.).
‡ Bull. Inst. Pasteur, iii. (1905) pp. 177–84 and 225–35 (figs. 1–21). See also Bot. Centralbl., xcix. (1905) p. 164.
§ Wochenschr. Brauerie, Bd. xxii. No. 8, p. 105. See also Centralbl. Bakt., xv. (1905) p. 61.
‖ Tom. cit., No. 9, p. 123. See also Centralbl. Bakt., xv. (1905) p. 61.

Lindner has taken up the question, and states that these flattened portions do exist, but that vacuoles are also present in the cells.* The subject is further discussed by Rommel, who supports Lindner as to the existence of vacuoles.

Fusion of Ustilago Conidia.†—Harry Federley distinguished two forms of conidia in *Ustilago Tragopogi-pratensis*. In one form each promycelium formed one conidium. As soon as the conidia were free they congregated in pairs and then formed a long germinating filament. Germination took place only in water; any addition of nutritive substance killed the conidia. In the other form numerous conidia were produced both in water and in nutritive media, but no copulation took place. A careful examination of the fused conidia showed that the nucleus from one conidium passed over and fused with that of the other conidium; after germination had begun the protoplasm of the conidium also passed over. Federley thinks that the fusion of the nuclei points to sexuality, though it is difficult to arrive at a decision.

Infection of Cereals by Smut Spores.‡—Ludwig Hecke has proved conclusively that there are two methods of infection of cereals by *Ustilago*. There is the attack of the seedling plant, and there is a more insidious infection of the seed in an early stage of development. Hecke watered developing flowers of barley with smut spores while the stigma was still quite fresh. When the seeds were developed he freed them from chaff, thoroughly sterilised the outer coats and left them to germinate for a while in sterilised conditions. Examination of the growing embryo proved the presence in the cells of healthy mycelium, which he concluded had been produced by the smut spores with which he had watered the flower. Further research is promised.

Deformation caused by an Æcidium.§—C. Massalongo describes the effect produced by *Æcidium Euphorbiæ* on the young shoots of *Euphorbia Cyparissias*, of which the roots and underground stem were invaded by the mycelium of the fungus. He gives an account of four different plants affected by the fungus. The shoot, the leaves, and the flower were all dwarfed or altered in growth: usually the shoots were sterile and the leaves hypertrophied and covered with the fructifications of the *Æcidium*.

Uredineæ.‖—Ed. Fischer brings to a close the account of his culture experiments with rust fungi. *Uromyces solidaginensis*, he finds, possesses only teleutospores. The *Æcidium*, on *Linosyris vulgaris*, is connected with a *Puccinia*, on *Carex humilis*. A *Melampsora* that occurs on *Larix decidua* and *Salix retusa* grows abundantly on the latter and on *Salix herbacea*, less freely or not at all on other species of willow. He also affirms the connection between *Æcidium leucospermum* and *Ochrospora Sorbi*.

* Wochenschr. Brauerie, Bd. xxii. No. 9, p. 123. See also Centralbl. Bakt., xv. (1905) p. 61.

† Oefversigt af Finska Vetensk. Soc. Forhandlingar, xlvi. (1904) No. 2, 23 pp. See also Bot. Centralbl., xcix. (1905) p. 223.

‡ Ber. Deutsch. Bot. Ges. xxiii. (1905) pp. 248–50 (1 pl.).

§ Bull. Soc. Bot. Ital., No. 5 (1905) pp 158–61.

‖ Ber. Schw. Bot. Ges., xv. (1905) 13 pp. See also Bot. Centralbl., xcix. (1905) p. 87.

J. C. Arthur* publishes a list of 54 species of rusts on Compositæ from Mexico. There are 18 new species recorded. Most of them have been collected by E. W. D. Holway. Diagnoses of the new species are published, with descriptive notes.

J. L. Sheldon† writes on "the effect of different soils on the development of the carnation rust." He planted a series of 170 cuttings of carnations in different soils, chiefly sand mixed with clay and organic matter, and inoculated all of them. Only 3 plants escaped the disease. He found as a result of soil influence that (1) the intensity of colour of the host-plant was proportional to the amount of clay in the soil; (2) the growth of the host was proportional to the amount of organic matter, nitrogen, and silt in the different soils; (3) the more gravel and sand in the soil, the longer it was before the uredospores broke through the epidermis after an inoculation had been made; (4) the soils that were favourable for the development of the host were also favourable for the development of the rust.

M. A. Carleton‡ gives his experience of rusted corn. Excess of moisture and delay in the ripening of the grain largely favour the spread of the rust. Certain kinds of wheat are less liable to attack than others, and some varieties are immune. Care should be taken to choose resistant varieties.

H. Snyder,§ in an account of rusted wheat, states that the glutinous material which should have gone into the grain was retained in the straw, making it better for feeding than ordinary clean straw. There is more protein present in both straw and grain when rust is there.

Polyporaceæ of North America.—XI. A synopsis of the brown pileate species.—W. A. Murrill‖ includes under his Polyporaceæ three sub-families, Polyporeæ, Fomiteæ, and Agariceæ. No new species are described, but many new genera are introduced. These are: *Coriolopsis*, *Flaviporus*, *Cerrenella*, *Nigroporus*, *Fomitella*, *Amauroderma*, and *Porodædalea*. Murrill gives a full synonymy and notes on the different species.

In a further paper¶ he continues the subject, and publishes a synopsis of the white and brightly-coloured pileate species. His rearrangement again necessitates a large number of new genera. These are: *Irpiciporus*, *Dendrophagus*, *Spongioporus*, *Rigidioporus*, *Earliella*, *Cubamyces*, *Coreoleolellus*, *Microporellus*, *Flaviporellus*, *Aurantiporellus*, *Aurantiporus*, *Pycnoporellus*, and *Pycnoporus*.

Mycological Notes.**—C. G. Lloyd publishes in No. 20 of his Notes an account of the Lycoperdons of the United States. They fall into the same groups as do those of other countries; a few of the plants described are identical with British species. He also describes the genus *Mitremyces*, the species of which grow in the more southern states of the country. No species is known from Europe, Africa, or S. America. All have the openings lined with red, and in one species

* Bot. Gazette, xl. (1905) pp. 196–208. † Tom. cit., pp. 225–9.
‡ U.S. Dept. Agric., Farmer's Bull., No. 219 (1905) pp. 1–24.
§ Bull. Min. Agric. Exp. Stat., xc. (1905) pp. 218–31.
‖ Bull. Torrey Bot. Club, xxxii. (1905) pp. 353–71.
¶ Tom. cit., pp. 469–93.
** Cincinnati, June 1905, pp. 2:1–44 (14 pls.).

the peridium also is bright red. Photographic figures of the plants and the cortex of each are published.

Hyphomycetes.* — G. Lindau completes his description of the Hyalodidymeæ, and begins the third division dealing with the colourless pluri-septate-spore forms, the Hyalophragmiæ. The author remarks on the great difficulty of accurately defining genera that shade into each other such as the parasitic genera *Cercosporella* and *Ramularia*. The latter he considers one of the most difficult to understand, and he foresees the splitting of many existing species, as well as the lumping together of others that are considered to differ.

Fungi of the Mark Brandenburg.†—A complete flora of this district is being issued, and the division "Fungi" has been undertaken by P. Hennings, G. Lindau, P. Lindner, and F. Neger. They begin with the Ascomycetes, and each writer deals with one or more groups. A scientific account is given, with a description of the life-history of each genus, and diagnoses and descriptions of the species that occur in the region. The writers have dealt, in the present part, with 42 genera and 88 species. References and synonymy are fully given, and there are figures to illustrate the genera.

American Mycology.—Several additions have been made to the fungus-flora in the present issue of the "Journal of Mycology." A. P. Morgan ‡ describes a new species of *Chætosphæria* that grew on old wood. Two new *Haplosporellæ* on dead branches have been found in Kansas by J. B. Ellis and G. Bartholomey.§ A number of new species and new records, mostly of Ustilagineæ and Uredineæ, are described by P. L. Ricker.‖ H. C. Beardslee¶ gives a short account of the Rhodosporæ among the Agaricaceæ, with notes on the genus *Clitopilus*. J. M. Bates,** in his "Rust Notes for 1904," gives an account of a *Puccinia* that occurs on *Distichlis*, the æcidium of which grows on *Chenopodium album*. He found the æcidia also on *Cleome serrulata*, on *Lepidium*, and on several other Cruciferæ. He proved by experiment the correctness of his observations. Charles Thorn †† offers "Some Suggestions from the Study of Dairy Fungi." He has made cultures of a large number of individuals of *Penicillium*, and he describes the more constant characters and those that would be of service in diagnosing and classifying the species.

Diseases of Plants.‡‡—Oskar Kirchner has issued the first part of a new edition of his text-book of the diseases of agricultural plants. His book is intended for cultivators who do not possess scientific knowledge. The host-plants liable to attack are in separate divisions: the flower and fruit are considered first, and abnormal appearances noted, with the

* Rabenhorst's Kryptogamen-Flora, Band i. Abt. 8, Lief. 98 (Leipzig, 1905) pp. 385-432.

† Kryptogamenflora der Mark Brandenburg, Bd. vii., Heft 1, Gebrüder Borntraeger (Leipzig, 1905) 160 pp.

‡ Journ. of Mycol., ii. (1905) p. 105.

§ Tom. cit., p. 108.

‖ Tom. cit., pp. 111-17.

¶ Tom. cit., pp. 109-10 (2 pls.).

** Tom. cit., pp. 116-17.

†† Tom. cit., pp. 117-24.

‡‡ Die Krank. und Beschäd. unserer landw. Kultur., Eugen Ulmer, Stutgart, 1905, Lief 1, pp. 1-96.

cause and the remedy. The other parts of the plant are also passed in review. A large part of the work describes the mischief due to insects; the fungoid pests are less numerous, but they appear under their appropriate headings. A chapter at the beginning describes the usual methods employed for the extirpation of the pests, and an account of the apparatus used.

Diseases of Cultivated Plants.—W. L. Lawrence* describes an apple disease called Black-spot—a canker caused by the fungus *Glœosporium malicorticis*. Both the tree and the fruit are attacked, and much injury is done. Preventive remedies are suggested.

J. L. Sheldon† gives an account of the diseases of Melons and Cucumbers during 1903–4. Various fungi are signalled as the cause of injury, but the most destructive disease was due to *Colletotrichum lagenarium*, which caused anthracnose of the Water-melon. Many culture experiments were made with the fungus.

E. Mead Wilcox‡ gives an account of diseases of apple, cherry, peach, pear, and plum, various kinds of canker, leaf-spots, rusts, scabs, etc., due to fungi, with a discussion of the best fungicides to use.

Karl Kornauth§ publishes an account of animal and plant diseases during 1904. He notes especially an attack of tomatoes by *Septoria Lycopersici*, a great development of *Erysiphe graminis* on barley, and of *Puccinia glumarum* on rye in Bohemia and Upper Austria.

H. von Schrenk‖ chronicles the occurrence of *Peronospora parasitica* on cauliflower in a greenhouse in Missouri. The case was of interest from the isolated and sporadic appearance of the fungus.

C. Clayton Smith¶ gives an account of plant diseases in Delaware. These were chiefly leaf-spot diseases on species of Cucurbitaceæ (Cucumber), Solanaceæ (egg-plant) and Leguminosæ (beans, etc.). The spots were due to various microfungi belonging to the Sphæropsideæ and the Pyrenomycetes.

Perley Spaulding** describes a disease of Black Oaks due to *Polyporus obtusatus*. The fungus gains entrance through a wound and extends through the heart-wood, changing the colour to yellow and then almost to white.

Studies in Myxobacteria.††—E. Baur thinks that Zederbauer has not seen any Myxobacteria; the symbiotic forms he describes have

* Washington Agric. Exp. Stat., Bull. lxvi. (1904) pp. 1–35 (12 pls., 67 figs.). See also Bot. Centralbl., xcix. (1905) p. 277.

† West Virginia Agric. Exp. Stat., Bull. xciv. (1904) pp. 120–42 (5 pls., 16 figs.). See also Bot. Centralbl., xcix. (1905) p. 279.

‡ Bull. Alabama Agric. Exp. Stat., cxxxii. (1905) pp. 75–142. See also Bot. Centralbl., xcix. (1905) p. 279.

§ Zeitschr. Landw. Versuch. Oesterr., 1905, p. 236. See also Centralbl. Bakt., xiv. (1905) pp. 653–4.

‖ Rep. Missouri Bot. Gard., xvi. (1905) pp. 121–4. See also Bot. Centralbl., xcix. (1905) p. 320.

¶ Delaware College Agric. Exp. Stat., Bull. lxx. pp. 1–16 (2 pls., 6 figs.). See also Bot. Centralbl., xcix. (1905) p. 310.

** Rep. Missouri Bot. Gard., xvi. (1905) pp. 109–116 (7 pls.). See also Bot. Centralbl., xcix. (1905) p. 311.

†† Archiv f. Protistenk., v. (1904) pp. 92–121 (1 pl. and 3 figs.). See also Bot. Centralbl., xcix. (1905) pp. 221–2.

nothing to do with this group of organisms. Baur describes his own experience in cultivating them in the laboratory. He found several forms already described, and a new species, *Myxococcus ruber*, of which he followed the development through all the different stages. He describes his methods of culture, and describes the most successful media on which to make the cultivations. He considers the Myxobacteria ought to be placed under the Schizophytes, and that they are near akin to the Acrasieæ.

ARTHUR, J. C.—**Rapid method of removing Smut from Seed Oats.**
[They should be treated with formalin before being sown.]
Purdue Agric. Exp. Stat., Bull. ciii. (1905) pp. 257–264.
See also *Bot. Centralbl.*, xcix. (1905) p. 326.

BAIL.—**Mittheilungen ueber Pilze.** (Contributions on Fungi.)
[Notes on the occurrence of rare forms and the development of some heterœcious Uredineæ described.] *Schriften Naturf. Ges. Danzig Neue Folge*, Bd. xi. (1904) pp. 65–71.
See also *Bot. Centralbl.*, xcix. (1905) pp. 220–1.

BARSALI, E.—**Aggiunte alla Micologia Pisana. Terza Nota.** (Additions to the Mycological Flora of Pisa. Third notice.)
[Gasteromycetes, Phycomycetes, and Myxomycetes are included in the notice.]
Bull. Soc. Bot. Ital., No. 6 (1905) pp. 201–5.

BOUDIER.—**Icones Mycologiques. Series I., Liv. 5.**
[20 plates are published in the present issue.]
Paris, Paul Klincksieck, Sept. 1905.

DIETRICH-KALKHOFF, EMIL.—**Beiträge zur Pilzflora Tirols.** (Contributions to the Fungus Flora of the Tyrol.) *Verhandl. K. K. Zool.-Bot. Ges. Wien* (1905) pp. 208–11.

GUILLIERMOND, A.—**Sur le nombre des chromosomes chez les Ascomycetes.** (On the number of chromosomes in the Ascomycetes.)
[The author finds 8 chromosomes present in *Pustularia vesiculosa*; Maire had seen only 4.] *Compt. Rend. Soc. Biol.*, lviii. (1905) pp. 273–5.
See also *Bot. Centralbl.*, xcix. (1905) p. 88.

HÄYRÉN, E.—**Verzeichniss der aus Finland bekannten Mucorineen.** (List of Mucors from Finland.)
[The list numbers 18 species.] *Meddel af. Soc. pro fauna et flora fennica*, heft. 29 (1904) pp. 162–4.
See also *Bot. Centralbl.*, xcix. (1905) p. 164.

HEDGCOCK, GEO. G.—**A disease of cauliflower and cabbage caused by Sclerotinia.**
[This was found to be *Sclerotinia Libertiana*.]
Rep. Mis. Bot. Garden, xvi. (1905) pp. 149–51.
See also *Bot. Centralbl.*, xcix. (1905) p. 224.

HOHNEL, FRANZ VON.—**Mykologisches.**
[Descriptions of new species, and notes on species already published.]
Oesterr. Bot. Zeitschr., lv. (1905) pp. 186–9.
See also *Bot. Centralbl.*, xcix. (1905) p. 138.

JACOBASCH, E.—**Boletus aurantiactis sp. n.**
[The new species resembles *Boletus elegans*. It is recorded from Jena.]
Mitth. Thür. Bot. Ver., xix. (1904) pp. 24–5.
See also *Bot. Centralbl.*, xcix. (1905) p. 166.

JAPP, OTTO.—**Fungi selecti exsiccati.**
[Ser. V., Nos. 101–25, Hamburg, 1905.] See also *Bot. Centralbl.*, xcix. (1905) p. 165.

KLEBAHN, H.—**Ueber eine merkwürdige Neubildung eines Hutpilzes.** (On the remarkable formation of a pileate fungus.)
[The formation of hymenium and gills on the surface of the pileus of *Tricholoma conglobatum* is described.] *Jahrb. Hamb. Wiss. Anst.*, xxii. (1904) Beiheft 3, pp. 25–30.
See also *Bot. Centralbl.*, xcix. (1905) p. 139.

KOSTYTSCHEW, S.—Ueber die normale und die anaërobe Atmung bei Abwesenheit von Zucker. (On the normal and anaerobic respiration in the absence of sugar.)
[Physiological experiments with *Aspergillus niger*; he finds that the two processes of respiration are closely connected.]
Jahr. Wiss. Bot., xl. (1904) pp. 563–92.

MARTIN, CH. ED.—Contribution à la flore Mycologique suisse et plus spécialement genevoise. (Contribution to the Swiss mycological flora, and more especially to the Genevan.)
[A list of fungi, with critical remarks on many of the species.]
Bull. trav. Soc. bot. Genève, ix., 1904–5 (1905) pp. 110–30.
See also *Bot. Centralbl.*, xcix. (1905) p. 166.

MASSEE, G., & C. CROSSLAND—The Fungus Flora of Yorkshire, a complete account of the known fungi of the county.
[A list of fungi, with the habitat, and name of the finder.]
Bot. Trans. Yorks. Nat. Union, iv. (1905) 396 pp.

OUDEMANS, C. A. J. A.—Catalogue raisonné des champignons des Pays-Bas. (Catalogue of the fungi of Holland.) *Verh. K. Akad. Wet. Amst.*, 558 pp.

PAZSCHKE, O.—Rabenhorst-Winter: Fungi europaei et extra-europaei exsiccati.
Editio nova, series secunda, centuria 25, Leipzig, 1905.
See also *Bot. Centralbl.*, xcix. (1905) p. 195.

PERRIER, A.—Sur la formation et le rôle des matières grasses chez les Champignons. (On the formation and function of fatty substances in fungi.)
[They are the product of a complex synthesis into which albuminoid substance enters, and they act as reserve bodies.]
Compt. Rend., cxl. (1905) pp. 1052–4.

SHEAR, C. L.—Fungous Diseases of the Cranberry.
[Species of *Guignardia* and *Glœosporum* attack the leaves and fruit, causing blast, scald, rot, and anthracnose.]
Farmer's Bull. U.S. Dept. Agric., xxii. (1905) (pp. 1–16.
See also *Bot. Centralbl.*, xcix. (1905) p. 142.

SZABÓ, ZOLTAN VON—Mykologische Beobachtungen. I. Fungi coprophili. (Mycological observations. 1. Coprophilous Fungi.)
Jahres.-Ber. Schles. Ges. lxxxii. (1905) Abt. 2, Zool.-bot. Sektion, pp. 16–21.

Lichens.

(By A. LORRAIN SMITH.)

Chroolepus aureus a Lichen.*—Albert Schneider has found that the cells of the alga *Chroolepus aureus* are constantly invested by fungal filaments, which form a delicate reticulation over the cells. The fungus grows ahead of the alga and forms a hollow network into which the algal cells advance. The association is not unlike that found in *Ephebe pubescens*. Schneider finds the association of fungus and alga so constant, that he thinks *Chroolepus* ought to be considered a lichen rather than an alga. No lichen fruit has ever been found on the plant.

Lichens from the Antarctic.†—Otto V. Darbishire has examined and determined the Lichens of the South Orkneys collected by R. N. Rudmose Brown, and he takes occasion to compare them with those found in other similar localities. There are 11 species, one of which, a fruticulose *Placodium*, is new to science. It grew abundantly on rocks, and somewhat resembles *Placodium coralloides*. Darbishire notes that the species, other than *Pl. fruticulosum*, are all Arctic plants, and he

* Bull. Torrey Bot. Club, xxxii. (1905) pp. 431–3 (1 pl.).
† Trans. Proc. Bot. Soc. Edinburgh (June 1905) 6 pp. (1 pl.).

draws attention to the great similarity between Arctic, Alpine, and Antarctic lichens. More records are needed before a complete understanding of these floras can be attained.

Lichenology for Beginners.*—J. Le Roy Sargent publishes No. III. of his papers explaining the structure and growth of lichens. He describes the principal forms assumed by the thallus, and the algæ that enter into relationship with the fungus. He then gives an account of the various forms of fruit, and instructs the student how to examine the spores.

Bruce Fink † also gives a paper on the same subject, especially on the microscopic study of Lichens. An account is given of the parts of the fruit, the apothecium, the disk, and the exciple. Other special structures, such as rhizoids, cilia, cephalodia, and cyphellæ, are described. The object of the paper is to call attention to the many features of Lichen-morphology which may be observed in the field with the aid of a hand-lens

Development of Lichen Fruits.‡—Gertr. P. Wolff has followed the development of the apothecia in a number of Lichen types: *Graphis elegans*, *Stereocaulon Paschale*, *Cladonia gracilis*, *C. degenerans*, and *C. furcata*, *Xanthoria parietina*, *Ramalina fraxinea* and *Lichina confinis*. In *Graphis elegans* carpogonia and trichogynes were constantly found, and numerous spermogonia. The trichogyne rises above the burst epidermis of the tree on which the lichen is established, and of which the vegetative development is entirely hypophlœodal. In *Stereocaulon* the apothecium was found to be of purely vegetative development. The carpogonia groups of hyphæ were reduced, and no sexual formation was present. In the species of *Cladonia* examined the sexual organs were found to be present, as also in *Xanthoria* and *Ramalina*. They were also presumably present in *Lichina*, but were not satisfactorily demonstrated.

BLOOMFIELD, E. N.—**Lichens of Norfolk and Suffolk.**
[A list of Lichens collected by the compiler and quoted from various authorities.] *Trans. Norfolk and Norwich Nat. Soc.*, 1904–5, pp. 117–37.

ZAHLBRUCKNER, A.—**Flechten, im Hochlande Ecuadors gesammelt von Prof. D. Hans Meyer im Jahre 1903.** (Lichens collected by Prof. D. Hans Meyer in the high lands of Ecuador in 1903.)
[A number of new species are described; the list contains 42 species.] *Beih. Bot. Centralbl.*, xix. (1905) pp. 75–84.

Schizophyta.

Schizomycetes.

Origin of Natural Immunity towards the Putrefactive Bacteria.§ R. Greig Smith has endeavoured to show :—(1) That there is a close analogy or identity between the production of bacteriolytic bodies and the digestion of food. (2) That bacteria do traverse the intestinal wall, and that negative experimental results regarding the same are untrust-

* Bryologist, viii. (1905) pp. 81–6 (17 figs.). † Tom. cit., pp. 86–90.
‡ Flora, xcv. (1905) pp. 31–57 (22 figs.).
§ Proc. Linn. Soc., N.S.W., 1905, p. 149.

worthy. (3) That natural immunity, especially towards the bacteria that normally inhabit the intestinal tract, is occasioned and maintained by the comparatively few bacteria which, in crossing the intestinal wall and possibly gaining access to the body fluids and organs, stimulate the cells to produce immune bodies. (4) That the agglutination of bacteria may play a much more active part in the production of immunity than is generally supposed.

Bacteria and the Gum of Hakea Saligna.*—R. Greig Smith finds that of the bacteria occurring in the tissues of this plant, the most probable producer of the gum is one intermediate between *B. acaciæ* and its variety *B. metarabinum*; but as we do not yet know that the host-plant can alter a gum once formed by a bacterium, it cannot be said that the gum is produced by this micro-organism.

Bacteria and the Gum of Linseed Mucilage.† — R. Greig Smith found that the gum bacteria in *Linum* are very numerous, and consist chiefly of two species.

(*a*) Short motile rods, from 0·3–1·0 μ long, with many peritrichous flagella, and not staining by Gram; producing on glucose-gelatin plate yellowish-white raised colonies with irregular margins; in stab culture there is a filiform growth in the track, and a broad nail-head at the surface, which sinks later in the liquefying medium. Grown in broth, it produces turbidity, a loose pellicle, and a coherent sediment. Indol is formed, and nitrates are reduced to nitrites. Milk becomes slightly acid.

(*b*) Large slightly motile rods, from 1·5–5 μ long, with many peritrichous flagella, staining irregularly by Gram. Oval spores often reniform were noted. Glucose-gelatin plates show circular, white, liquefied areas. On saccharose-potato-agar streak, a broad raised translucent white slime was formed. Grown in broth, the medium remained clear, producing flocculent deposit, and slight surface ring. Indol reaction was obtained; nitrates were not reduced to nitrites. Milk was slowly peptonised with the production of acid.

Oligodynamic Action of Copper Foil on Intestinal Bacteria.‡—H. Kraemer finds from his own experiments and the results of other observers that the presence of metallic copper in water destroys *B. coli communis* and *B. typhosus*. The toxicity is due to copper in a crystalloid form; and when copper foil is placed in distilled water, sufficient copper is dissolved in 1–5 minutes to kill bacteria within 2 hours.

The toxicity may be lost or neutralised by various substances, and the oligodynamic action depends on temperature. The effects of oligodynamic copper on the purification of drinking water are much the same as filtration, except that *B. typhosus* and *B. coli* are completely destroyed.

* Proc. Linn. Soc., N.S.W., 1905, p. 136. † Tom. cit., p. 161.
‡ Proc. Amer. Phil. Soc., xlix. (1905) pp. 51–65.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Note on a Microscope Presented by Linnæus to Bernard Jussieu.† The Microscope herewith presented for the inspection of the American

Fig. 159.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Reprinted and illustration reproduced, by permission, from the Proceedings of the American Society of Microscopists (now the American Microscopical Society), vol. ix. 1888, pp. 214-15. The instrument was exhibited and the description read at the meeting of the Society held at Pittsburg, Pa., on September 1, 1887. In connection with this instrument, it is interesting to recall Mr. Frank Crisp's letter anent Linnæus and the use of the Microscope, see this Journal (*ante*, p. 253).

Society of Microscopists, says Jacob F. Henrici, was found in a lumber room of the Harmony Society, a German community at Economy, Pennsylvania (fig. 159). It contains, in a drawer at the base of the stand, a Latin inscription, signed by Bernard Jussieu, setting forth that he received the instrument from his very dear friend Linnæus, as a gift of friendship, in lasting memory of the pleasant intercourse which they had at Paris in the month of August 1738. The Microscope is said by the present aged members of the Harmony Society to have belonged formerly to Frederick Rapp, one of the founders of the Society, who came to America from Germany in 1804, and who died at Economy in 1834. He was a man of considerable culture, and much of the prosperity of the community was due to his intellectual activity. No one knows when or how the instrument came into his possession, or what use he made of it. The body of the Microscope is of pasteboard, or papier-mâché, with wooden mountings, and fixed vertically on a wooden stand. It is provided with a draw-tube, and the adjustment is by means of a screw. Ten objectives accompany the instrument, each consisting of a single lens, ranging in focal distance from about a quarter of an inch to an inch. The lenses range in diameter from six millimetres to a centimetre; but when in position they are stopped down by brass caps to an aperture of about two millimetres diameter. Unfortunately one of the lenses of the eyepiece is lacking, and in order to exhibit the power of the instrument, I have replaced it for the moment by a corresponding lens from my working Microscope. No maker's name appears on any part of the instrument. The inscription, in full, is as follows:—

Audax Iapeti genus
Ignem fraude malâ gentibus intulit
Nil mortalibus arduum
—*Hor. Carm. Lib.* i. 3.

In perpetuam memoriam
consuetudinis quam cum
dulcissimo suo sodali
Carolus Linne Parisiis
habebat hoc ab eo amicitiæ
donum accepit, mense
Augusto, MDCCXXXVIII
Bernardus Jussieu.

Aside from the interest attaching to this Microscope from its association with two of the great scientific workers of the last century, it is encouraging to compare our Microscopes of to-day with this crude instrument, which Jussieu deemed worthy of the admiration expressed in Horace's line, "Nil mortalibus arduum."

Wilson Screw-Barrel Simple Microscope.—This instrument, fig. 160, was kindly presented at the October Meeting by Major Meade J. C. Dennis, who says that its date is about 1750, and that it belonged to his great-grandfather. The Society has two other specimens of the Wilson Screw-Barrel Microscope in its collection; one bears the name of Sterrop as maker, and the other, without a name, was presented to the Society by Mr. C. Curties at the June Meeting, and will be found figured and described in the Journal for October, pp. 636–7.

These three examples differ from each other in detail, though they are very similar in general construction, and are after the pattern as made by Adams.

The history of Microscopes focusing by means of a *screw cut on the barrel* dates back to Campani in 1686, though this arrangement was preceded in 1665 by Hook, whose Microscope was focused by means of a screw *cut on the nose* of the instrument. Grindl followed in 1687, and Bonanni in 1691. Hartsoeker, in 1694, further developed this system of focusing, and his instrument was clearly the prototype of the Wilson, which was published in 1702. Probably before 1738 Culpeper applied a pillar with folding tripod base to the Wilson model; he also provided an attachment by which it could be converted into a compound Microscope. The Society possesses two examples of this instrument, the workmanship of which is very beautiful. Finally, Adams produced his model, which had a great sale, and was produced by other makers.

Fig. 160.

The instrument presented by Major Dennis is in very good condition. It has five powers, the usual lens carrier for viewing opaque objects, and forceps for holding the objects; the stem of the forceps when thus used is passed through small holes in the screwed barrel at the back of the stage plates, as seen in the figure. These holes are referred to in Adams' description, but are not visible in his figure of the instrument, and this is the only example in the Society's cabinet—including the Culpeper examples—that is provided with this particular method of holding the forceps. There is also a double-ended box containing ten slides, having forty objects mounted between talcs in the manner then common.

Watson's Praxis and Bactil Microscopes.*—W. Watson and Sons have recently brought out a new model, which embodies an advantageous method of construction. Solid castings from specially constructed

* W. Watson and Son's Special Catalogue (September 1905) 12 pp., 11 figs.

FIG. 161.

Fig. 152.

moulds replace separate pieces screwed together. Thus the foot and pillar and the stage and limb are both cast in one solid piece. The two pieces are connected by a strong knuckle joint, upon which the instrument is inclinable to the horizontal. As far as the stand is concerned, there is

FIG. 163.

no difference between the Praxis (fig. 161) and Bactil (fig. 162) models. The important feature of the latter is a new form of mechanical stage, which has a travel of 2 in. horizontally and 1½ in. vertically. The horizontal movement (fig. 163) can be removed by unscrewing two

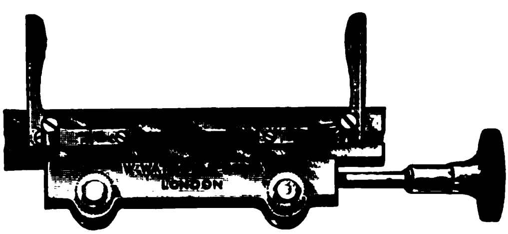

FIG. 164.

thumb-screws, leaving the surface of the stage 3½ in. square, as shown in fig. 164. The compound substage is fitted with focusing rackwork and centring screws, and can be turned out of the optic axis when desired. Other accessories supplied are a coned iris diaphragm and a spiral focusing screw with Scop condenser in lieu of the one previously described.

Beck's "Imperial" Metallurgical Microscope.—This Microscope (fig. 165) is a modification of the Imperial Microscope, specially made for metallurgical purposes, in which the large concentric rotating stage is replaced by a square mechanical stage, the whole of the stage and sub-

stage being capable of focusing up and down to an extent of 2 in. The body is 2 in. in diameter, and a photographic lens may be placed in

Fig. 165.

the centre for photographing large objects, with a rack-and-pinion draw-tube and sliding draw-tube, which as well as the nose-piece, are removable.

The slow motion has a double-speed lever action patent slow motion invented by Mr. Ashe. The whole instrument is very massive, the spread of the tripod being 8½ inches by 9 inches, the height of the optic axis 9½ inches, the maximum distance from the nose-piece to the stage 6 inches.

A powerful clamp is supplied to the joint, and a square hole in the limb of the Microscope allows illuminating apparatus to be carried on the Microscope itself.

R. & J. Beck's Metallurgical Microscope, "London Model."—This metallurgical Microscope (fig. 166) is on the model of the "London" Microscope, except that it is carried on a much larger pillar and base. The latter, which is unusually large and steady, measures 6¾ in. in length by 4½ in. in width.

The coarse focusing adjustment is by spiral rack-and-pinion, so accurately fitted that even comparatively high powers can be focused thereby. The fine adjustment consists of a triangular prism upon which slides smoothly a solid metal sleeve which fits this prism so perfectly that there is no lateral motion. The adjustment is obtained by a fine micrometer screw actuating a supplementary pointed rod which impinges upon a hardened steel block. The limb of the Microscope is so designed that there is ample room for the fingers when turning the milled heads.

The body is made of a large diameter, 1·27 in., No. 3 Royal Microscopical Society's standard gauge, so that a large angle of view can be obtained for photo-micrography, or large field eye-pieces can be used if desired.

The stage is carried on an exceedingly strong dovetailed slide, and has a rack-and-pinion focusing motion up and down of 2 in.

The mechanical stage gives vertical and lateral motion of 1 in. and is very solidly constructed. If the mechanical stage is not supplied, a square stage, 3¾ in. by 3¼ in. of solid construction is supplied.

A substage with screw-focusing adjustments is supplied in the most complete form, but the instrument may be supplied with or without this adjustment. A double mirror and strong case accompany each instrument.

Ashe-Finlayson Comparascope.—By the use of this apparatus (fig. 167), exhibited at the October Meeting, exact comparisons may be made of two objects which may be seen side by side in the same field of view. For certain classes of microscopical work this is most valuable. It is applied without any difficulty to any ordinary monocular Microscope, as the apparatus may be screwed in like an object-glass and be clamped at any convenient position so that it projects at right angles to the body of the instrument, either in the front or to one side or the other, according to the most convenient position from which to take the light.

The whole apparatus, by means of an adapter A, fig. 168, screws into the body of the Microscope in place of the object-glass, and the ordinary object-glass screws into the apparatus as shown at O 1.

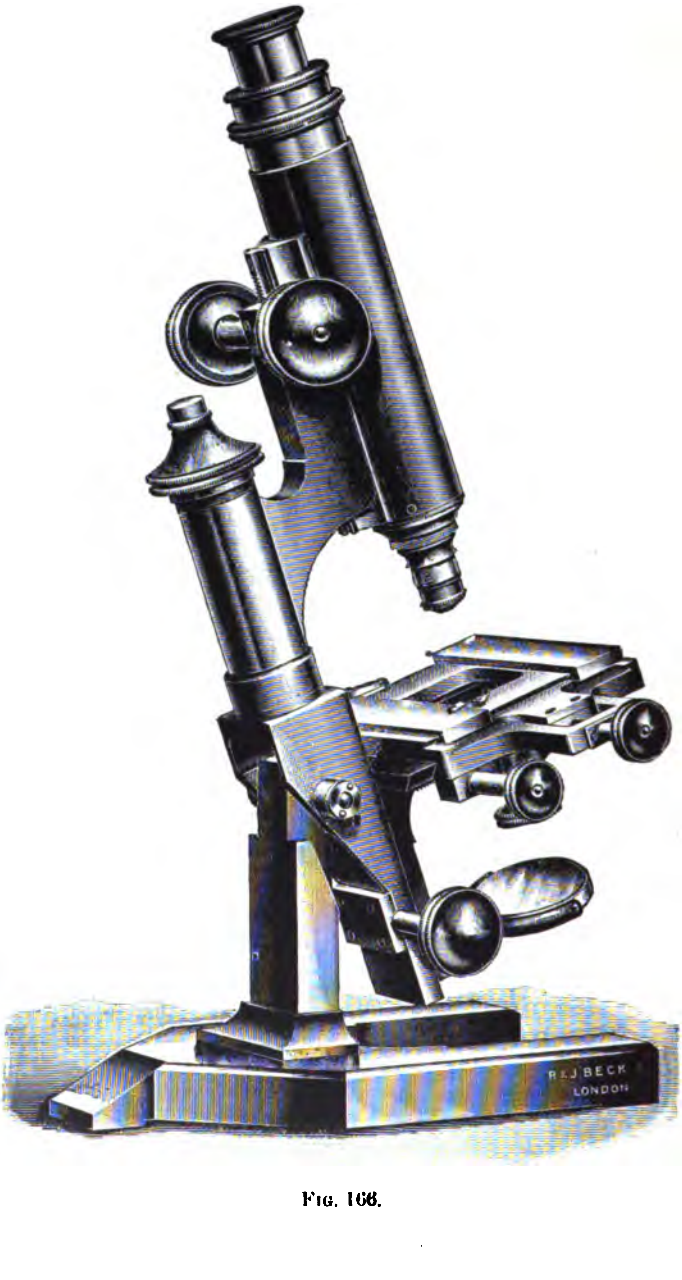

Fig. 166.

The Comparascope consists of a mount into which a second object-glass O 2 can be screwed at right angles to the body tube. A strong but very light dovetailed bar D projects about 3 in. from the Microscope tube, and carries upon it a movable stage S, upon which an ordinary 3 in. by 1 in. slide is held by spring clips. At the far end of the dove-tailed bar slides a mirror M in gimbals, and in the centre of the com-parascope mount is a right angle prism P, which reflects the light from the object-glass O 2 into one half, while the light from object-glass O 1 proceeds directly to the other half of the field of the Microscope.

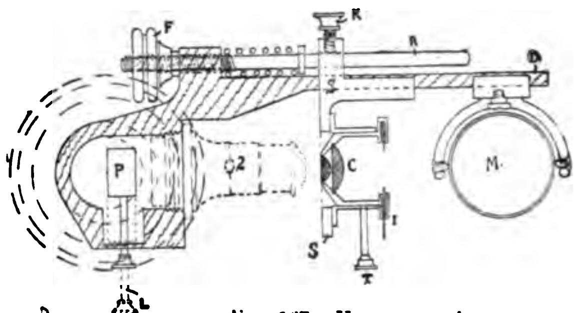

FIG. 167.—VIEW FROM ABOVE.

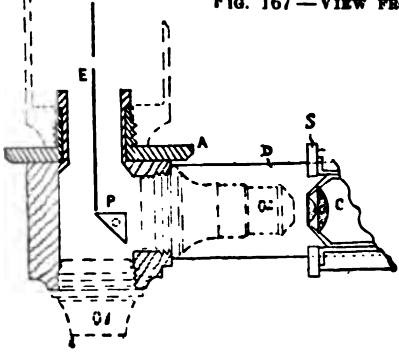

FIG. 168.—SIDE VIEW.

Fitting into the Comparascope mount is a thin septum E, which projects sufficiently far into the body tube to prevent the light from one side of the field reaching the other half. The prism P can be slipped out of position by means of the milled head L at any time, thus throwing the Comparascope out of use. The stage S which slides along the dovetail D, may be clamped in any position by the screw K upon the rod R, and a fine adjustment for focusing high powers is then available by revolving the milled head F. In order that the instrument may be equally serviceable for high powers, a small substage carrying a condenser C,

with an iris diaphragm I, is supplied. The condenser may be focused by means of the milled head T, which acts through a spiral slot and moves it up or down.

The partition E should be of suitable length for the Microscope with which the Comparascope is to be used, so that it is advantageous in ordering the instrument to state the length of the tube of the purchaser's Microscope. Any Microscope object-glasses can be employed, though it is generally convenient to use a pair of object-glasses of approximately the same magnifying power. For those who have not duplicate object-glasses, these can be supplied, the powers of which will be sufficiently similar for ordinary work. Where extremely delicate observations are to be made, specially paired object-glasses can be obtained. In this case the two images are identical in magnifying power. The apparatus, which has been patented, is made by the firm of R. and J. Beck, who are the sole licensees.

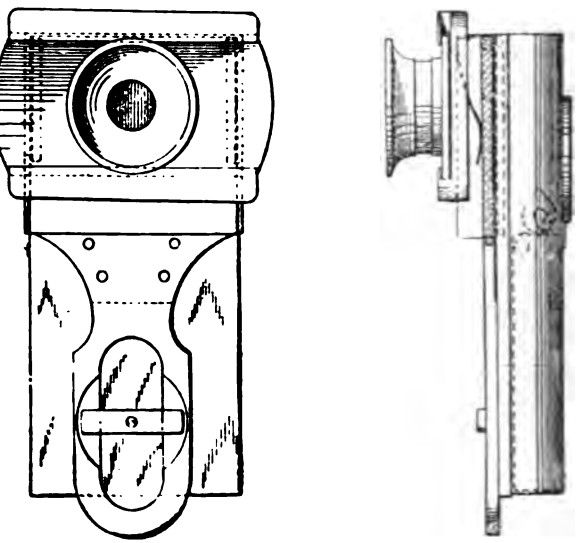

FIG. 169.

Vollbehr's Microphotoscope.—This apparatus (fig. 169) was described in the October Journal, p. 642.

Reichert's New Microscope Stands with Handles.*—The principal feature of these stands is the handle, a convenience which will be much appreciated in laboratories and in class work. The illustrations

* Reichert's Special Catalogue, 1905, 16 pp.

FIG. 170.

(figs. 170–171) give the appearance of the instruments fitted with the new accessory, and also the class of model to which they have been adapted.

FIG. 171.

The addendum is an economical substitute for the bent-out limb which has only of recent years been properly appreciated.

(2) Eye-pieces and Objectives.

Direct Determination of the Curvature of Small Lenses.*—C. V. Drysdale exhibited and described apparatus for the direct determination of the curvatures of small lenses, such as the objectives of Microscopes. Parallel light from a distant source falls upon a plane unsilvered mirror inclined at an angle of 45°. Some of the light is reflected and brought to a focus by an ordinary convex lens. The surface to be tested is placed at this point, and the reflected rays proceed as if they had come from a point on the surface. They pass through the plate glass into a telescope focused for parallel rays, and an observer sees an image of the distant source. If the surface is convex and is brought nearer to the lens, then, when it reaches such a position that its centre of curvature is at the focus of the rays emerging from the lens, the light will again retrace its former path, and a distinct image of the source will be seen in the telescope. In order to obtain the two images, the surface has therefore been moved through a distance equal to its radius of curvature. If the surface is concave, it must be moved away from the lens. The author showed how the method could be carried out by means of an auxiliary piece fitted to an ordinary Microscope. He also described a method of testing the spherical and chromatic aberration of microscopic objectives. Light from a distant point is partially reflected by means of a piece of plate-glass down the axis of the Microscope. In passing out of the objective it is brought to a focus upon a mirror, and retraces its path along the axis of the instrument until it reaches the plate glass. It passes through, and by means of a telescope an observer can view the distant source. The light having passed twice through the lens to be investigated, the effects of chromatic and spherical aberration are doubled, and at the same time the effect of coma is eliminated.

(3) Illuminating and other Apparatus.

New Ultra-Violet Mercury Lamp (Uviol Lamp).†—O. Schott and those who work with him at problems involving ultra-violet rays have found "Uviol" a convenient abbreviation. In the construction of this lamp full advantage has been taken of that new Jena glass which is pervious to ultra-violet rays. Platinum wires are fused into the extremities of a suitably shaped, generally straight, uviol-transmitting glass tube of from 8 to 30 mm. diameter, and of a length of from 20 to 130 cm. The platinum wires terminate inside the tube in the form of carbon heads, and admit of the use of either pole as positive or negative. Interiorly the lamp requires a mercury charge of from 50 to 150 grm. according to its size. The purpose of the mercury is not only to supply the vapour required for illumination, but also to effect the starting and to divert heat in order to cool the negative pole. The lamp is started by tilting; the two poles then become connected by the mercury, the current having, of course, been previously switched on. At the first moment of contact between pole and mercury, part of the

* Nature, lxxi. (1904) p. 142.

† Schott and Ger., Jena, Pamphlet No. 421, 16 pp., 1 pl., 1 fig.; Nature, 1873 (1905) p. 513.

latter is disintegrated simultaneously with the formation of a column of light and of an induction track for the current, which continues after the return of the mercury into its original position. The inconvenience of the long tube may be reduced by adopting a U-shape, which not only reduces the length to one-half, but is found to facilitate the starting and to enlarge the illuminated area. This shape is also more convenient for application to various parts of the human body. Several of these lamps may be electrically joined side by side, above or below, or in such ways as may be found desirable. The spectrum of the uviol lamp is exceedingly rich in lines, and extends down to wave-length 253. The specific intensity of the visible radiation fluctuates between 0·31 and 4·3 Hefner candles per sq. cm. according to the dimensions of the lamp. It follows that the uviol-lamp is an extremely advantageous means of converting electrical energy into effective radiating energy of short wave-length. It is likely to be useful not only in photography but in many chemical investigations, and in certain skin diseases. It has a deadly effect on bacteria and minute living organisms, as well as on the smaller species of insects. Under a lamp suspended during a summer night in a room with windows opened, thousands of dead insects were swept up the following morning.

Beck's Eyeshade.—This eyeshade (fig. 172), to obscure the unemployed eye in monocular Microscopes, is specially adapted for Beck's instruments.

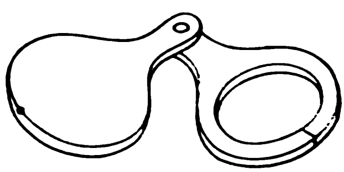

FIG. 172.

Abbe Camera Lucida.—This camera lucida (fig. 173) is a cheap form of the Abbe Camera Lucida, and has a cubical prism which is

FIG. 173.

provided with a series of rotating tinted glasses. The holder carrying the prism and tinted glasses can be thrown on one side on a pivoted

joint. The instrument, which is made by the firm of R. and J. Beck, is used in the vertical position.

Beck's Parabolic Illuminator.—This apparatus (fig. 174) consists of a mirror made of glass, silvered at the back. The construction was suggested by Mr. Stead as being preferable to a solid silver reflector, which becomes tarnished when used in the presence of chemicals. The apparatus slides on the barrel of the objective, and is thus kept central, and the focusing is effected by moving it up or down. The light should

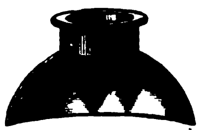

FIG. 174.

be thrown upon it from one side by means of a condensing lens, or otherwise from a lamp on the same level. The light is then converged upon the object in an oblique cone. When in use the lower edge almost touches the object. It is provided with an extra sleeve for fitting it to two object-glasses. It is only suitable for low powers.

Beck's Parabolic Illuminator with Sorby's Reflector.—This (fig. 175) is similar to the preceding, but has the addition of a silver mirror at 45° on a swinging fitting, which can be placed over half the front of

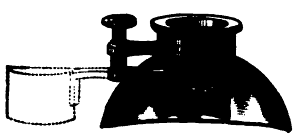

FIG. 175.

the object-glass, and throws a direct beam of light upon the object. With this apparatus the effects of oblique and direct light can be rapidly contrasted. It is only suitable for low-power lenses having a long working distance. This has both reflectors made of silvered glass as in the preceding illuminator.

STREHL, K.—**Beleuchtungsprincipien.** *Central.-Zeit. f. Opt. u. Mech.* (1905) pp. 227–8.

(4) Photomicrography.

Vertical and Horizontal Photo-micrographic Camera.—This consists of a strong metal base, which carries by means of a hinged bracket a solid circular bar. This rod has sliding upon it two strong brackets, the upper one of which carries a frame with folding ground glass and runners to take a double dark slide for photographic plates 6½ in. by 4¾ in.; the lower bracket carries a tubular sleeve which fits loosely but in a light-tight manner over a tube which may be attached to the eye-

piece end of a microscope (fig. 176). The two brackets are each attached to bellows, and are capable of an extension of about 30 in. The two brackets slide easily up and down the circular bar in a slot or key-way, which prevents their turning round. They are provided with clamp screws to hold them rigidly at any position on the bar.

The whole camera may be used in a vertical position over the

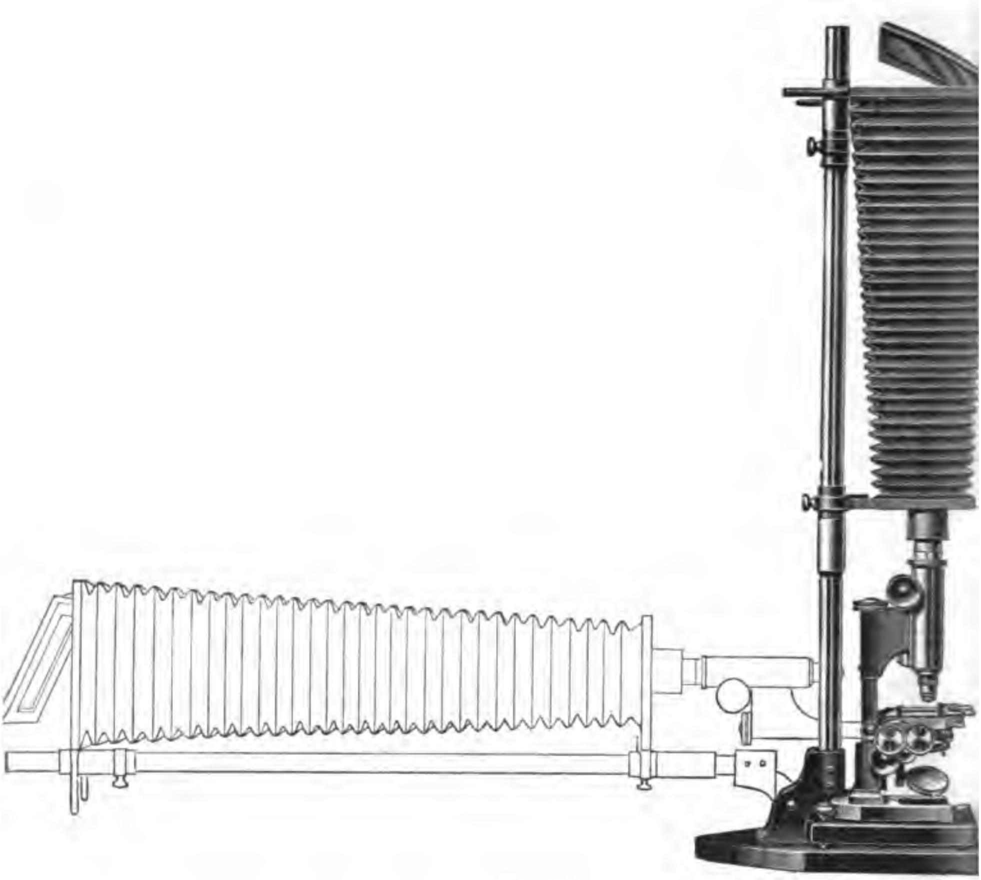

Fig. 176.

Microscope, or in a horizontal position as shown by the outline in figure, in which case the extreme end stands upon two firm feet on the table.

A small table with three levelling screws is supplied upon which the Microscope stands, and may be adjusted for centring the picture.

The apparatus, which is made by the firm of R. and J. Beck, also includes a one ½-plate double plate-holder, carriers for ¼-plates, and light-tight connection for Microscope.

Focusing Magnifier.*—This instrument (fig. 177), made by Taylor, Taylor and Hobson, of Leicester, is intended for examining the definition of an image on the camera screen, and is arranged to close like a tele-

FIG. 177.

scope for compactness. The screw-ring forms an adjustable stop to limit the withdrawal of the eye-piece to suit the sight of the user.

LEADBEATER, L.—**Photographing Crystals.**
[Lecture at Rotherham Photographic Society.]
English Mechanic, lxxxii. (1905) pp. 152–3.

MARKTANNER-TURNERETSCHER, G.—**Wichtigere Fortschritte auf dem Gebiete der Mikrophotographie und des projektionswesens.**
Separat-Abdruck aus Jahrbuch f. Photog. und Reproduktionstechnik f. das Jahr 1905. Halle a. S., Wilhelm Knapp.

(5) Microscopical Optics and Manipulation.

Braun's Methods of Identifying Sub-microscopic Structures; Allied Investigations on Double Refraction.†—F. Braun has found that certain substances—e. g. electrically pulverised metals, produce a grating-like structure when viewed with polarised light. This effect is in full agreement with the electro-magnetic theory of light. It has also been found that certain organic substances specially treated with gold solutions give similar effects. Hence it would seem that, either the finely-divided gold, or some compound of the gold and the organic substance, must be anisotropic. Braun's experiments were all made with transparent light, but similar results have now been attained with reflected light. It appears from these later experiments that the light which vibrates parallel to the grating-bars is reflected more intensely than that in the perpendicular direction. This, again, is in accordance with theory and with the behaviour (only reversed) of the transparent light. The method of observation is to place the object on the stage in the usual way, and to arrange above it a cover-glass inclined at 45° to the horizontal. The plane is set horizontally, and polarised light is then made to impinge on the cover-glass; it is then reflected downwards through the object to the mirror; is again reflected, and passes

* Catalogue, 1905, p. 23.
† Central-Zeit. f. Opt. u. Mech., xxvi. (1905) p. 188.

through the inclined coverslip into the objective. By means of a Zeiss vertical illuminator, high magnifications and oil immersions could be applied. It was found that palladium dust gave the best results.

The examination of organic preparations involved greater experimental difficulties. The light from an electric arc projection lantern was passed through a diaphragm and focused by a lens through another diaphragm and a ground glass screen on to a Zeiss vertical illuminator, which reflected it down through the Microscope tube and the objective on to the mirror, which again reflected it upwards through the preparation on to the Nicol eye-piece. An arrangement was also made so that the mirror might reflect directly upwards, thereby enabling a comparison observation with transmitted light to be made. Braun succeeded in accurately identifying by this means the composition of a substance previously unknown to him. The arrangement of apparatus for examination by reflected polarised light is more difficult and elaborate than in the case of transmitted polarised light, but the results give a useful criterion for detecting how far the images are due to any double refraction possessed by the substance itself. The author describes several of his methods for obtaining polarised light.

Microscopical Determination of the Position of a Reflecting Surface during Optical Contact.*—K. Prytz-Kopenhagen, when the surface is a plane reflecting solid, sets on the plane a suitable object (e.g. a grating on a glass plate) appropriately illuminated. This is then viewed through a Microscope whose axis is perpendicular to the plane. The position of sharp definition will be the position of optical contact. In the case of a reflecting liquid, its surface is, of course, plane, and the Microscope is arranged as before. But into the body of the Microscope near the eye-piece focus is introduced a horizontal solid glass rod, whose outer end is opposite a light source, and the inner (i.e. inside the tube) is bent vertically in the axis of the Microscope. The end of this vertical portion is accurately plane and horizontal, and bears two fine diamond scratches $\frac{1}{40}$ mm. apart. These scratches project an image through the objective towards the reflecting surface, and when adjusted the image will be in the reflecting surface, and will be the conjugate point of the glass rod end. In this position the image on the reflecting plane may now be regarded as origin. Just above the objective is a prism of very obtuse angle, the edge being uppermost. The effect of the prism is to throw the ray proceeding from the origin on to the reflecting surface slightly out of the microscopic axis, so that it reaches the eye-piece without being blocked out by the glass rod. Thus, the position of clear definition of the scratches will again be the position of optical contact. Descriptions are given of the application of the method to the measurement of Newton's rings and of other physical quantities.

BRASS, A.—**Grundgesetzeder Optik.**
[Deals largely with interference.]
Central.-Zeit. f. Opt. u. Mech., xxvi. (1905) Nos. 15–20.

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* Central-Zeit. f. Opt u. Mech., pp. 242–4 (3 figs.).

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivating Trypanosomes.† — Thiroux cultivated *Trypanosoma duttoni* in the following medium: beef or rabbit broth, 1000 grm. (125 grm. of meat macerated in 1 litre of distilled water), Witte's pepton 20 grm., salt 5 grm., agar 20 grm., carbonate of soda solution (53 grm. to the litre) 10 c.cm.

The materials are prepared and mixed in the customary way, except that the medium is not clarified with white of egg. When made, it is sterilised in the autoclave for 20 minutes at 110°, and preserved in tubes covered with caoutchouc caps.

When required for use the necessary quantity is melted in a water bath and when cooled down to 45°, two volumes of defibrinated rabbit's blood are added. It is then made into slopes, and next day the inoculations are made in the condensation water, the blood being taken from the heart of a mouse. The first cultures develop in from 10–15 days; from these sub-cultures are made, and so on until development occurs on the 4th day.

In order to stain the Trypanosomes, thin films are necessary. The preparations are fixed in absolute alcohol and stained by Laveran's method.‡

Cultivation of Amœbæ.§—A. Lesage inoculated gelose with mucus from dysenteric stools. The gelose, which had been washed in running water for 8 days and afterwards sterilised, was placed in Petri's capsules or in tubes. The temperature ranged from 18°–25°. In a few days amœbæ, often motionless, were found buried among the bacteria. Cultivations were also made on plates on which paracolon bacilli were growing. By this method living amœbæ were obtained from the human intestine without passing through the encysted stage.

Another method was to allow the amœbæ to become encysted, and to cultivate the cysts thus obtained. For this purpose some mucus and a little sterilised water were placed in a covered capsule. The mucus dried slowly at a temperature of 18°–25°. After a few days the dried mucus was sown on gelose plates. In this way about one vessel out of ten was found to contain amœbæ. Each successful plate served to obtain fresh cultures of the pure mixed cultures. Each time the plates were inoculated the amœbæ were sown at the bottom of the plate while held vertically, the upper end being inoculated with the food bacterium. The plates were incubated at 20°. After a few days the amœbæ reached the upper end, and from this part fresh plates were inoculated, and so on.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Ann. Inst. Pasteur, xix. (1905) pp. 566–9 (1 pl.).

‡ See this Journal, 1903, p. 117, and 1904, p. 120.

§ Ann. Inst. Pasteur, xix. (1905) pp. 10–16 (2 pls.); Comptes Rendus, cxxxix. (1904) pp. 1237–9.

All stages in the evolution of the amœbæ were able to be followed out in the cultivation plates.

For staining purposes the methods of Laveran and of Marino were used.

New Bacteria Filter.*—F. Kern describes a new bacterial filter. As seen from the accompanying illustration (fig. 178) it consists of a porcelain cup, the bottom of which is perforated and holds the filter candle, with the blind end upwards and the open end fixed into the hole in the bottom of the cup; beneath this there is a connecting pipe that leads into the lumen of the candle; the cup, candle and connecting pipe are made out of one piece of porcelain; the cup and pipe are glazed; by means of a rubber cork the connecting pipe can be attached to a vacuum flask. When the cup is full of the fluid to be filtered, the candle is covered by a glass bell, shaped like the candle but rather larger; by this means the action of the vacuum is not hindered by the air that would otherwise be drawn in above the filtering level of the candle, and it is not essential that the cup should be completely full of fluid. The author claims that it is a simple contrivance, being composed only of one piece of porcelain and a glass globe, both of which can be readily cleaned and sterilised; that it will filter relatively small quantities of fluid; that it is inexpensive.

FIG. 178.

Pure Culture from Cells Isolated under the Microscope.†—S. L. Schouten obtained pure cultures from single cells isolated under the highest powers of the Microscope, by means of fine glass needles controlled by a special mechanism. The apparatus employed is represented in fig. 179 as $\frac{1}{4}$ natural size. It consists of A an iron plate standing on four feet; the Microscope is fixed by a ring to the square copper plate B, and can be moved by means of a screw to the right or left or backwards or forwards. Of the Microscope there is shown the stage F, the Abbe condenser G, the iris diaphragm H, the mirror I, the foot J, and the objective K; on the stage is a moist chamber, the "isolation chamber," which has a special construction, the right and left sides being provided with horizontal clefts, which can be closed by thick oil; through these clefts are passed two needles M, to be described below. On to the moist chamber, which can be moved by means of a mechanical stage, is brought the cover-slip, on the under side of which the isolation will take place. The needles are provided with handles N, resting on the copper bar O, which can turn about a pivot P, and at the

* Centralbl. Bakt., 1te Abt., xxxix. (1905) p. 214.
† Zeitschr. wiss. Mikrosk., xxii. (1905) p. 10.

ends of these bars are small steel disks, by means of which they rest on the vertical rods R; by means of the spring S, R can be screwed up or down, the point of M in the moist chamber falling if R is screwed up, and conversely; the screw on R has a very fine adjustment, and the arm of the lever O is about twice as long as the distance of P to the point of the glass needle, so that very minute changes in position can be made; the pivot P is carried by a copper bar V, which is fixed in the upright T. The glass needles have a stouter portion over the position of the rod O of about 3–4 mm. thick, opposite the pivot P about ½ mm., and the fine ends are formed into points and loops, and vary in stoutness according to the nature of the organism to be isolated. The Microscope being placed in position, the needles are laid in cement on the holders, and are so arranged that the looped ends are directed upwards, resting almost in the middle of the objective, but rather deeper than the upper margin of the isolating chamber; the side clefts are closed, the cover-glass laid on top of the chamber, and the needles are now pressed so deeply into the cement, that by moving the screw S the ends can be made to rest on the under side of the cover-glass; the

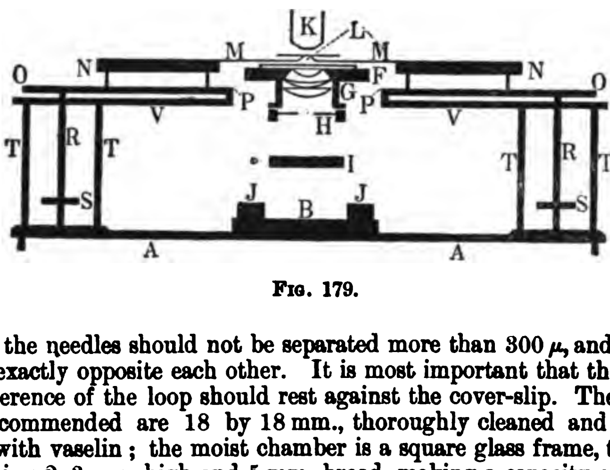

FIG. 179.

ends of the needles should not be separated more than 300 μ, and should not be exactly opposite each other. It is most important that the whole circumference of the loop should rest against the cover-slip. The cover-slips recommended are 18 by 18 mm., thoroughly cleaned and lightly spread with vaselin; the moist chamber is a square glass frame, the side walls being 2–3 mm. high and 5 mm. broad, making a capacity of about 14 by 14 mm.

Before proceeding to the isolation of the cell, it is necessary to ascertain how much of the material from which the isolation is to be made must be added to a drop of ¾ p.c. salt solution, so that there are not too many cells at the margin of the drop; the author gives details of the method he employs to determine this suitable dilution.

The suitable dilution being decided on and prepared in the specially devised mixing chamber, the cover-slip on which the isolation is to be made, is flamed and laid on the mixing chamber; then with a sterilised platinum needle are placed near to each other and equally distant from the middle of the slip and rather to its left side, three drops of the sterilised fluid in which the culture is to be made; these are known as the "culture drops"; to the right of the middle and about 2 mm. dis-

tant from each other, are placed two drops of a ¾ p.c. salt solution containing the material in the desired state of dilution; these are known as the "material drops"; besides these is also placed one drop of sterilised ¾ p.c. salt solution. The isolating glass needles are now sterilised; this is done by taking away the loose side pieces of the isolation chamber, and by turning off the screw with which N is fixed into O; N is drawn carefully away from the apparatus; the points of the glass needles are then held in a flask of strong sulphuric acid, and afterwards in a flask of ammonia; they are then returned to the plate, the movable side pieces replaced, and the side slits closed with thick olive oil. A drop of water has been previously placed on the floor of the isolation chamber. The cover-glass is seen to be studded with small rounded drops, indicating that the chamber is saturated with steam.

Under a low power the points of the needles are dipped into the drop of sterile ¾ p.c. salt solution. By a movement of the Microscope, the loop of the left-hand needle, now full of salt solution, is brought, under a high power, exactly into the middle of the field; the right-hand needle being about three screw-turns beneath it. By means of the movable stage and a low power the isolation chamber is so placed that the left-hand loop rests almost on the margin of a material drop, that is on the margin that lies nearest to the culture drops. With a high power the margin of the drop is searched for a bacterium to isolate, a part of the margin being chosen where there are not many other bacteria; then the outer end of the loop of the needle is brought into contact with the margin, whereby a little fluid will be withdrawn from the drop; the isolation chamber is then moved a little, so that the small drop of fluid containing the bacterium is separated from the material drop. The isolated bacterium has now to be transferred to one of the culture drops. Using a low power, the chamber is moved so far to the right, that the loop of the left-hand needle when raised, arrives between two culture drops and near to the margin of one of them; then under a high power, the loop is brought against the cover-slip, where it deposits a drop that probably contains the isolated bacterium; several drops are deposited until this is made certain. To bring the isolated bacterium into the culture drop, the pointed end of the right-hand needle is used; under a low power the left hand needle is drawn three screws'-rings down, and the right hand needle is raised and brought by the sliding arrangement of B, exactly under one of the drops in which there is an isolated bacterium; then under a high power the point of the right-hand needle is made to rest on the cover-slip in the drop, and by moving the isolation chamber the point of the needle carries the drop with the bacterium into the culture drop, the bacterium being kept in sight during the process. Diagrams illustrating the stages of this manipulation accompany the description. The author gives minute details for carrying out these processes, for correcting errors, and for avoiding possible difficulties, and refers to the modifications required when dealing with various micro-organisms, and especially when the method is employed for testing the favourableness of any particular medium. He considers that the method is especially useful for studying variability and pleomorphism.

Method for Collecting the Gas of Fermentation.* — A. Cache recommends the following method: Having poured the fluid medium into an ordinary test-tube, he places in it a small short test-glass inverted, and brings the whole into the autoclave; during the process of sterilisation, all the air in the small tube has escaped, and, after cooling, it is seen to be full of medium. On testing sugar bouillon inoculated with an organism capable of causing fermentation, the gas produced will collect in the inverted tube.

(2) Preparing Objects.

Examination of the Spermatozoa of Ascaris megalocephala.† — L. Scheben gives the following details of the method employed by him in the examination of the male genital organs of *Ascaris megalocephala*: The specimen is obtained as fresh as possible, and put into the fixing solution, a mixture of 50 parts of absolute alcohol, 50 parts of mercuric chloride, and 2 parts of acetic acid, or picric acid as used by Boveri; or Zenker's solution may be used. The material is cut up into small pieces, and left in the fixing solution for 12 hours, and after removal of the mercury by means of iodine solution, it is placed in 60 p.c. alcohol, and from this it is transferred to alcohols of progressively higher percentages up to absolute alcohol, in which it should not be allowed to remain too long when once the desired hardness has been reached. The object is now placed in xylol, or better, in pure chloroform, covered by a layer of absolute alcohol, to protect the specimen that floats on the surface of the chloroform, from the air; when the object is sufficiently penetrated, the alcohol can be pipetted off, and the specimen is transferred to a mixture of xylol, or chloroform and paraffin, and after about half an hour it is imbedded in pure paraffin. The imbedding process lasts about 4 hours at 60° C. Sections were then made ranging from 4 μ to 10 μ. Good staining was obtained by Heidenhain's hæmatoxylin method, and counterstaining with a light green; simple picrocarmine staining also answered well; the author also stained with anilin dyes, using the double stain of Heidenhain's hæmatoxylin and Bordeaux red. Besides making sections, he also examined the contents of fresh genital glands from the living animal, by means of a warm stage, in albumen-glycerin or in a weak solution of sugar; or he fixed the contents expressed on to a cover-slip, in osmic acid vapour, or by the method suggested by Van Beneden and Boveri, and mounted in glycerin.

Methods of Examining the Eyes and Frontal Organs of Branchiopods.‡ — M. Nowikoff finds that Gilson's fluid is the best for fixing these objects, but he also got good results with sublimate acetic, or with 96 p.c. alcohol. For the thicker sections, that served to show the topographical relations, he stained with borax-carmine and ½ p.c. Lyons blue, or borax-carmine, osmic acid, and wood vinegar, after Schuberg, or with Delafield's hæmatoxylin and picric acid fuchsin, according to Van Gieson. This last is also very good for fine sections; but he found that for these, in order to show the plasma structure, Bütschli's or M. Heidenhain's

* Centralbl. Bakt. Ref., 1te Abt., xxxvii. (1905) p. 49.
† Zeitschr. wiss. Zool., lxxix. (1905) p. 400. ‡ Tom. cit., p. 433.

hæmatoxylin, or R. Heidenhain's hæmatoxylin potassium chromate is especially useful. Referring to the borax-carmine stain, he notes that the nuclei of the Branchiopods have very little stainable substance, so that he stained the object for about 48 hours at 35°–40° C.

For decolorising the eyes he uses free chlorine by a modification of Mayer's method; he fills a test-tube with 96 p.c. alcohol, adds a few drops of nitric acid, and puts a couple of crystals of potassium chlorate into the mixture; into the lower half of the tube he dips a thin layer of wool, and lays it on the head of the animal, which had been previously kept in 70 p.c. alcohol; in this way the object does not rest on the potassium chlorate; in 12–24 hours at room temperature, the pigment will be completely removed from the tissue, which has not suffered any marked alteration from the treatment.

Investigating the Anatomy and Development of the Venous System of Chelonia.*—F. A. Stromson killed the turtles with chloral hydrate, and injected through the left abdominal vein. The best results were obtained when the animals were killed several days before injecting them. The mass used was mostly gelatin, and in order to prevent it cooling before all the veins were filled, the specimens were previously placed in warm water. If, however, iodide of potassium is used to lower the melting-point of the gelatin, this is not necessary. Some of the turtles were injected with Huntington's wax-mass, and corroded with strong hydrochloric acid.

The material used for studying the development of the veins of embryos was fixed in picro-sublimate. The embryos were dehydrated, cleared, and imbedded in paraffin, and serial sections were cut about 20 μ thick. The best staining results were obtained from Delafield's hæmatoxylin and picric acid. Reconstruction methods were freely used.

Demonstrating the Structure of Gutta-percha Plants.†—A. Charlier, when investigating the anatomy of gutta-percha plants, used collodion sections of the leaf, and stained them with acetic orcanette, with orcanette and chloral, or with sudan, in order to demonstrate the lacticiferous network. It was found easy to macerate little bits of leaf in eau-de-favelle, and, after carefully washing in dilute acetic acid, to stain the tissue *en masse*. The maceration in the hypochlorite varied according to the thickness of the leaf, from 24 hours to several days. These preparations were mounted in glycerin-gelatin.

In order to study the walls of the lacticiferous vessels, the latex was got rid of by immersing the sections in chloroform. The sections were then cleared up in hypochlorite and afterwards stained with iodine-green and alum-carmine. Bismarck brown and Delafield's hæmatoxylin gave equally good results.

Demonstrating the Structure of the Respiratory Tract of Birds.‡ For demonstrating the bronchial ramifications of birds, G. Fischer made corrosive preparations by the aid of wax-masses, celloidin, photoxylin, and celluloid solutions.

* Amer. Journ. Anat., iv. (1905) pp. 453-4.
† Journ. Bot., xix. (1905) pp. 133–4.
‡ Zoologica, xix. (1905) 45 pp., 5 pls. and 2 figs in text.

The wax mass consisted of 3 parts white wax, 2 parts powdered colophonium, 1 part Venetian turpentine. The mass was stained with Berlin blue or with cinnabar. The mass was injected while the body of the bird was still warm, and when the operation was completed the body was cooled down in cold water, and then, after the lapse of a few hours, was transferred to pure hydrochloric acid for maceration. When the maceration was complete, the preparation was cleansed in running water.

The photoxylin and celloidin injections are made by dissolving the commercial article in equal parts of absolute alcohol and sulphuric ether, and mixing the mass with zinc-white or cinnabar.

The solution injected is at first of a thin, syrupy consistence, afterwards followed by a thicker. As the solvents evaporate quickly, it is necessary to give a few turns of the piston-screw from time to time so as to keep the tension up. According to the size of the animal, it takes hours or days for the injection mass to set properly. After having been macerated in pure hydrochloric acid, the preparation is washed in running water, and afterwards preserved in a mixture of alcohol, glycerin, and water.

As hydrochloric acid did not always act satisfactorily, the following corrosive menstruum was substituted: oxalic acid 6, pepsin 1·5, distilled water 200. This medium was used, after preliminary treatment, with hydrochloric acid, and the digestion was effected in a thermostat at 40° C.

Celluloid injection masses were chiefly used for blood-vessels. Celluloid shavings were dissolved in pure acetone, and the solution mixed with cinnabar or zinc-white.

For microscopical sections, the thoracic viscera (trachea, lungs, and heart) were placed within a bell jar, from which the air could be exhausted below and gelatin solution made to flow in above.

For fixing the material for microscopical purposes, five methods were tried: absolute alcohol; formalin, alone and with the addition of 5 p.c. acetic acid, and of saturated solution of sublimate; Zenker's and Müller's fluids. The sections were stained by Van Gieson's and by Weigert's methods, and with kresofuchsin.

Creosote as a Dehydrating Medium for Imbedding in Paraffin.* W. Pavlow recommends the following procedure, which he finds has advantages over the usual method of dehydrating with alcohol. The objects, fixed in any kind of fluid, are transferred without previous dehydration to creosotum fagi for 4–24 hours, according to size, and then immersed in pure creosote for 2–3 hours more. On removal, the superfluous creosote is mopped off with blotting paper, and then the objects are placed in xylol or toluol for one hour, after which they are imbedded in paraffin in the usual way.

Injection of Fine Vessels.†—P. Konascko successfully and easily injects the organs of small animals by the following procedure. When it is desired to inject, say, the portal system of the kidney of the frog, a canula is introduced into the vena cava inferior or the vena abdominalis anterior. These large vessels are then injected with warm colourless

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 186–7.
† Tom. cit., pp. 179–80.

gelatin. The organ is, of course, placed in a water-bath during the injection. When the operation is completed, the preparation is removed and allowed to cool. It is now easy to insert a canula into the finer vessels, which are distended by the injection-mass. When the canula is fastened, the preparation is placed in warm water again. After an immersion of a few minutes the gelatin is liquefied, and then the injection-mass is easily syringed in.

Demonstrating the Spermatogenesis of Hydra.*—E. B. Downing used a variety of fixatives, including osmic-Merkel, Hermann's, Perenyi's chromacetic, Flemming's, Gilson's mercuro-nitric, Carnoy's acetic-alcohol, Kleinenberg's picro-sulphuric, Graf's chromoxalic, varying strengths of picro-acetic, and hot corrosive. The first three were the best, the osmic-Merkel working especially well. A $\frac{1}{2}$ p.c. solution of osmic acid was used to kill the animals. The hydra was placed in a watch-glass, in as small a drop of water as would allow the animal to expand well. When expanded, about 10 c.cm. of the osmic-acid solution was poured over it, death mostly occurring without any contraction. After about a minute the animal was transferred to Merkel for 24 hours. It was then dehydrated in graded alcohols, cleared in xylol, and imbedded in paraffin. A variety of stains was used, the best being iron-hæmatoxylin, Bordeaux red, orange G, and safranin-gentian-violet.

The preparations were cleared with oil-of-bergamot or cedar-oil, and the sections mounted in balsam or in thick cedar-oil.

The best results were obtained from the osmic-Merkel or the Perenyi, followed by iron-hæmatoxylin and Bordeaux-red, or for count of chromomeres, by safranin. Gentian-violet was the best stain to differentiate the gland-cells of the endoderm, and was used after iron-hæmatoxylin.

Decalcification of Dental Enamel.†—C. F. Bödecker remarks that by the ordinary methods of decalcification, the protoplasmic constituent of the enamel of teeth is torn off from the dentine and gets washed away. This disaster is avoided by the following procedure: The preparations pass through the usual processes until they come to thin celloidin. From this they are transferred to the decalcifying solution, which consists of thick celloidin solution, to which 6–10 p.c. strong nitric acid has been added. The consistence of the solution must be maintained by the occasional addition of ether and alcohol.

The duration of the decalcifying process depends on the size of the preparation—e. g. slices about 30 μ thick are ready within two weeks, while those 1 mm. thick require about two months.

After the preparation has lain in the acid solution for a couple of days it assumes a chalky appearance, but as decalcification proceeds the enamel becomes transparent, so that at last it is almost imperceptible.

When this stage is reached, the celloidin is allowed to harden.

On account of the difficulty of making thin celloidin sections, it is advisable to imbed the block in paraffin.

* Zool. Jahrb., xxi. (1905) pp. 379–426 (3 pls.).
† Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 190–2 (1 pl.).

Demonstrating the Blastoderm of Polistes pallipes.*—W. S. Marshall and P. H. Dernehl killed the eggs in hot water, and after a few seconds added an equal amount of hot saturated aqueous solution of sublimate. After an immersion of 20–40 minutes the eggs were washed and placed in 70 p.c. alcohol. Another method used consisted in adding to hot sublimate solution an equal bulk of alcohol and pouring the mixture over the eggs, and allowing this to act for 10–20 minutes.

The stains used were iron-hæmtoxylin, generally followed by Bordeaux red, and the safranin-methylen-violet, orange G triple stain.

Preparing Fasciolaria tulipa and its Larval Excretion Organs.† O. C. Glaser found that the best fixative was Kleinenberg's picro-sulphuric acid. The stains used were borax-carmin, hæmalum, Kleinenberg's hæmatoxylin, and Conklin's modification of Delafield's hæmatoxylin. In some cases bleu-de-Lyon and eosin in combination were tried.

There was some difficulty in obtaining thin sections, as dehydration rendered the yolk very brittle. For paraffin sections the best results were obtained by superseding the higher alcohols and xylol with 70–80 p.c. alcohol and creosote. This procedure enabled thin sections of a mass containing some 300 eggs to be easily made.

Demonstrating Neurofibrils.‡—G. A. Jäderholm rejects the existence of an endocellular network in ganglion-cells, and shows that the appearances are due to fixation, his view being that the fibrils pass through the cells without inosculating.

He advocates Bethe's method, which consists in fixing with nitric acid, following this with molybdanate of ammonia and toluidin-blue. This procedure causes little shrinkage, and the appearance of an endocellular network is absent. By Donaggio's method, which consists in substituting pyridin for nitric acid as fixative, the cells become shrunken and the appearance of an inosculating endocellular network is produced.

By combining the two methods, shrinkage and artefacts intermediate in degree were produced.

Demonstrating the Structure of Red Corpuscles.§—Vl. Růžička washes the air-dried films with a mixture of tap and distilled water in order to remove the hæmoglobin. The films are then fixed in saturated aqueous solution of sublimate. After thorough washing in running tap water they are mordanted with 5 p.c. sodium nitrate and then washed again. The films are stained with a mixture of 2 parts of 5 p.c. carbol-fuchsin and 1 part of 1 p.c. aqueous china-blue solution.

After washing in water the preparations are dried and mounted in Balsam or in cedar-oil.

Demonstrating Teeth of Mammalian Embryos.‖—K. von Korff fixed the material, teeth of embryos of ox and pig, in sublimate, sublimate-alcohol-acetic acid, and in Flemming's fluid. The last two have the advantage of not dissolving out the slight deposit of lime. The

* Zeitschr. wiss. Zool., lxxx. (1905) pp. 122–54 (2 pls.).
† Tom. cit., pp. 80–121 (2 pls. and 5 figs.).
‡ Arch. Mikr. Anat., lxvii. (1905) pp. 103–23 (2 pls.).
§ Tom. cit., pp. 82–102 (2 pls.). ‖ Tom. cit., pp. 1–17 (1 pl.).

preparations were stained with solution of acid Rubin and orange G in alcohol and glycerin, or they were first stained with Heidenhain's iron-alum hæmotoxylin.

(3) Cutting, including Imbedding and Microtomes.

Reichert's Microtome with Handle.*—This instrument (fig. 180) is a modification of the microtome working in conical bearings previously

FIG. 180.

described in this Journal.† The new features are the handle and the base, which is sufficiently heavy to insure stability.

Flatters' Microtome.—This microtome‡ (fig. 181) devised by A. Flatters is made of brass; the tube or well is 3 in. deep and the extreme diameter 1 in. The spindle is of the same length, the screw having 28 threads to the inch. The spindle is fitted with a thumb-screw at the lower end to admit of the toothed disks being easily changed. A spring stop, the tension of which can be adjusted, works on the teeth of the disk, thus insuring a series of sections of uniform thickness. The

* Special Catalogue, 1905, p. 9.
† See this Journal, 1899, p. 499.
‡ Exhibited at the October Meeting, 1905.

three disks provided have 72, 54 and 43 teeth, giving sections $\frac{1}{2000}$, $\frac{1}{1500}$ and $\frac{1}{1200}$ in. respectively. The thickness of the sections is ascertained by multiplying the notches in the disk by the number of threads per inch on the spindle.

FIG. 181.

FIG. 181A.

The knife-plate, $2\frac{3}{8}$ in. by $4\frac{3}{4}$ in., is made of hardened brass polished "dead flat," and has an aperture the same diameter as the tube, but tapers slightly to the top in order to prevent the specimen from turning

or rising while the sections are being cut; it is attached at one end to the headstock by a stout screw, and is securely held in position by a reliable screw which is clamped under the headstock. The specimen to be cut is placed in the well of the microtome, and paraffin, m.p. 130° F.,

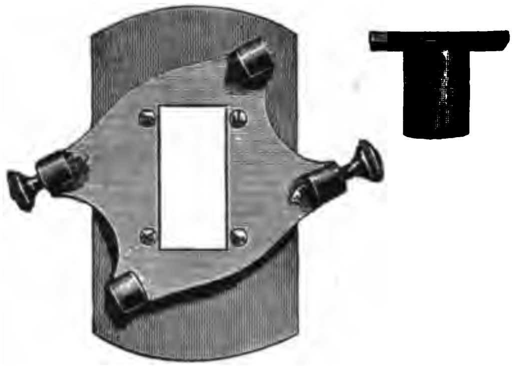

FIG. 181B.

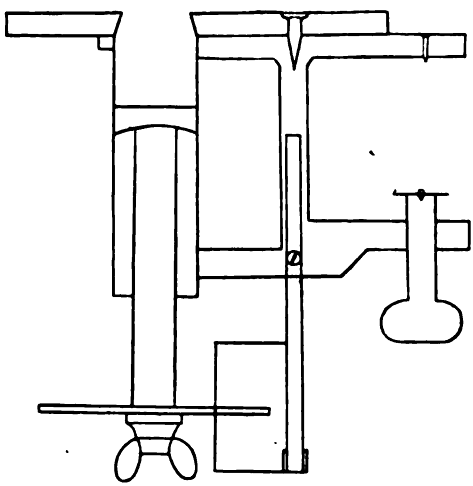

FIG. 181C.

poured in; when set, any superfluous wax is removed. The "candle" so formed is then moved upwards by turning the toothed disk. The sections are cut by passing the knife obliquely over the knife-plate, which is always kept moist with alcohol.

The instrument is fitted with an oblong top for sections too large for the ordinary well; it fits on the top of the microtome and is held in position by a series of clamps; the aperture is ⅞ in. wide by ½ in. long by 1⅛ in. deep. The carrier fits into the tube of the microtome, and is actuated by the spindle in the usual way.

FIG. 181D.

Preventing Rolling of Paraffin Sections.*—In order to prevent the rolling and crumbling of paraffin sections, A. Siding works up a little bit of paraffin with the fingers on to a thin, transparent plate of the same size as the section surface, and presses it on the section surface of the paraffin block. With a little practice the right pressure for obtaining intimate union is attained. When the section is made, this, together with the plate, is easily removed with the finger to a slide already provided with adhesive. For very large sections, just warmed paraffin should be poured over the section surface. The further manipulation is the same as that for ordinary paraffin sections.

(4) Staining and Injecting.

Easy Method of Staining and Mounting Algæ and Fungi.†—J. Burton, in a paper read at the Quekett Microscopical Club, remarked that in exhibiting micro-objects to friends who were not particularly well acquainted with natural history, it was always noticeable that they showed most interest in "common objects." A fly's foot or scales from a butterfly's wing drew more attention and gave more pleasure than rarer objects which were not understood. Among the objects suitable

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 177–8.
† English Mechanic, lxxxii. (1905) pp. 272–3.

for popular exhibition, nothing could be more beautiful, when properly displayed, than the very common "moulds," which were universally familiar, and, indeed, only too often more familiar than welcome. But there was considerable difficulty in mounting them, or even in preparing them for exhibition as temporary mounts for transmitted light. This was due partly to the fact that the spores were very readily shed, and the whole plant disorganised, in the dry air of a room, and partly to the difficulty of getting water to penetrate effectually among the hyphæ. Some years ago a friend had sent him a bottle of fluid and some specimens of micro-algæ preserved in dilute spirit, with the directions, "Wash out the spirit and mount in the fluid." The result was very satisfactory, staining and permanent preservation being effected at the same time, with only one medium. The method was found to answer equally well with fungi, the only difficulty lying in the preliminary process. The fluid consisted of glycerin to which an alcoholic solution of Hoffman's blue was added in sufficient quantity to obtain the desired tint. It was essential that the blue should be of the best quality if permanent results were wanted. Methylen-blue could be used as a substitute, but the colour faded quickly.

The method of mounting was as follows:—A drop of alcohol of strength 80 p.c. to 90 p.c. was placed upon a glass slip. A small portion of the fungus was placed with as little disturbance as possible in the alcohol, which at once penetrated the fungus. The alcohol quickly evaporated and another drop was then placed on the object, which was left to soak in it for about a quarter of an hour. Then a drop or two more of dilute spirit, say 25 p.c. strength, was added. When this had penetrated the specimen, the slide was left undisturbed for several hours, care being taken to insure that the fluid did not evaporate altogether. By these processes the initial difficulty of the resistance to wetting was overcome, and at the same time the tissues were fixed and hardened. After some hours (or sooner if convenient) the spirit was washed out with distilled water. This was done on the slide with a camel-hair brush, with which some of the superfluous spores were at the same time removed. While the object was still wet a drop of the coloured glycerin (diluted if the object is a delicate one) was placed on the fungus and allowed to soak in thoroughly. It was a good plan at this stage to put the slip away in the cabinet for a time. Finally, the specimen was arranged under a Microscope, the diluted glycerin withdrawn with a brush, and a drop of glycerin of full strength substituted. The cover-glass was then placed in position and cemented down. Unless the object was thick no cell was required. The algæ could be treated in the same manner, but were much easier to deal with, as they did not require such delicate manipulation in the early stages.

Apparatus for Staining simultaneously Numerous Sections.*— The apparatus devised by L. Neumayer consists of two hoops, *a* and *b*, united by cross-pieces *e*, *e* (fig. 182). The hoops, which are 2·9 cm. high, are 7·9 cm. apart, a distance which easily admits the insertion of the ordinary slide. Upon the cross-pieces rest the two rings *d* and *e*,

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 181–5 (1 fig.)

which serve to support the slides. On the inside of *a* are 80 fillets 1·8 cm. high, the space between adjacent pairs being about 0·4 cm. The inner hoop *b* has eight fillets, which are about 2 cm. apart. At the intersection of the cross-pieces is inserted a T-shaped piece, which serves, through the mediation of a hook, for removing the frame from the solutions. The frame is made of cast iron, covered with white enamel, and, when filled with slides, weighs about 400 grm.

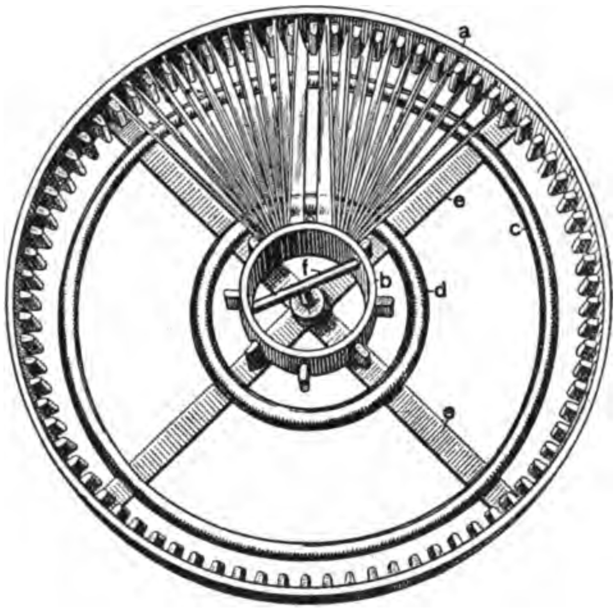

Fig. 182.

Demonstrating the Neurofibrils in Ganglion Cells.*—A. Gemelli places pieces 1 cm. square in a mixture of 3 p.c. bichromate of potash and 1 p.c. osmic acid, in the proportion of 1 : 8 ; a few drops of sulphocyanide of potash are added, and after an immersion of about half-an-hour the pieces are transferred to the customary osmic-bichromate solution. In from 48–72 hours the pieces are passed into the nitrate of silver solution. Sections were made by the celloidin method.

Apparatus for the Simultaneous Staining of Several Sections fixed to Cover-slips or Slides.†—K. Melissinos has devised this apparatus (fig. 183). It consists of a square box K, 80 mm. long, 45 mm. broad and high ; on the inner wall of one side is a plate A, provided with grooves, which is held fast by a small knob *kn*. The

* Anat. Anzeig., xxvii. (1905) pp. 449–62 (6 figs.).
† Zeitschr. wiss. Mikrosk., xxii. (1905) p. 130.

plate A has twenty grooves R, to receive twenty slides and forty cover-slips. Parallel to the plate A and inside the box is another plate B provided with the same number of same sized grooves; by means of the long arm *a r*, this plate is connected with the screw *s*. If the screw is turned the plate B can be brought nearer or farther away from the fixed plate A. One of the grooved plates carries at its lower margin and on the inner surface a fine thread which projects 5 mm. over the surface, and so serves to prevent the plate from falling down into the deposit of stain at the bottom of the vessel. The movable plate B has at either side two notches, to facilitate the circulation of the staining solution, washing fluid, etc. Various sized and shaped glasses can be placed

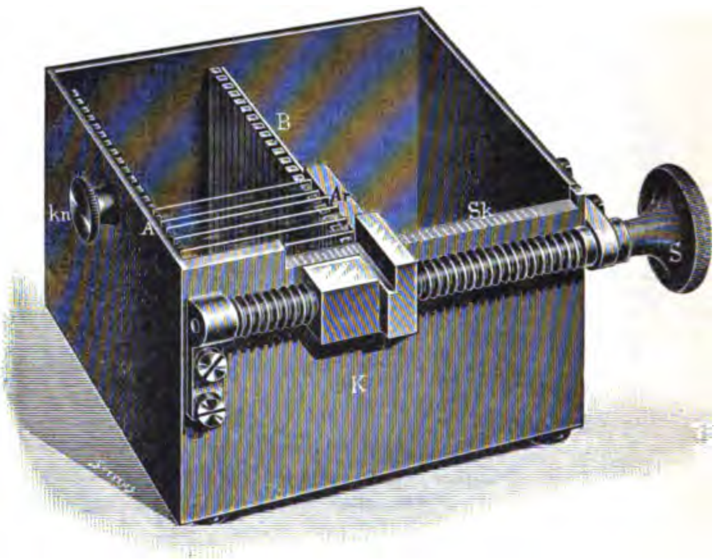

FIG. 183.

upright in the box; the size of the slide for which it is to be adjusted being engraved on a scale *sk* in mm.

The advantages claimed for this apparatus are that it can be used for slides or coverslips; that, by adjusting the screw, the slides and slips can be held fast in the grooves, and do not fall out when the various stain fluids are poured off; and also with one apparatus a quantity of material fixed to slides can be treated in a short space of time.

Examination of the Retina of the Nautilus and certain Dibranchiate Cephalopods.*—H. Merton found that retinæ of these animals did not stain by the usual nuclear and plasma dyes; with Delafield's hæmatoxylin he obtained only a diffuse staining, and with borax-carmine he had no result, but he was more fortunate with the stronger staining

* Zeitschr. wiss. Zool., lxxix. (1905) p. 326.

anilin dyes, such as toluidin blue and Unna's polychrome methylen-blue. With toluidin blue he applied a mordant, using either ammonium molybdate, after Bethe, or antimonium tartrate (tartar emetic) according to Schuberg. With this method he could demonstrate the nerve fibrillæ; he used as a control stain the iron-hæmatoxylin method of M. Heidenhain, after which he stained with a 1 p.c. aqueous solution of acid fuchsin, and obtained a most useful appearance; also R. Heidenhain's stain with aqueous hæmatoxylin and a subsequent mordant of chromate of potash gave good results; he also obtained good preparations of very thin sections with the iron-hæmatoxylin method of Butschli —acetate, iron oxide, and aqueous hæmatoxylin. Sections of 3 μ or less were only obtained if the retina had been separated from the underlying thick layer of connective tissue before imbedding. To obtain thin sections of the retina in conjunction with the connective tissue he employed Mastix collodion after Heider.

To bleach the pigments he used a mixture of 85 parts of 96 p.c. alcohol and 15 parts of nitric acid, and a knife's-pointful of KCl or $KClO_3$, care being taken that the object does not remain for long in contact with the KCl or $KClO_3$, lest the tissue be destroyed.

For fixing the eyes of the Dibranchiates he found Zenker's mixture was especially good. For staining he used Heidenhain's iron-hæmatoxylin combined with acid fuchsin or orange; and besides these he used Blockmann's fluid that stains the nerve fibres pale yellow, the other constituents staining blue, and he obtained excellent results by combining this reagent with borax-carmine, osmium, and wood-vinegar.

Theory of Vital Staining.*—V. Růžička, as the result of extended research, has elicited a difference in the staining relations of living and dead protoplasm, living protoplasm staining red, dead protoplasm staining blue, when treated with an equimolecular mixture of neutral red and methylen-blue. The method consists of mixing equal parts of 0·05 p.c. solution of neutral red and methylen-blue in distilled water; some of the mixture is dropped on a clean slide and allowed to evaporate at 35° C. in the incubator; on to the dried layer of stain is brought the object in the same isotonic medium, which serves equally as a solvent for the stain mixture. In seeking to explain his results the author considers that living substances exist in a more or less fluid condition, and consist of two layers of different densities, an outer denser and an inner more fluid; and he conceives that when such a cell is surrounded by fluid its outer layer would behave, in respect to the separate fluids, as a membrane; and, assuming that the staining process proceeds according to the laws of simple diffusion, and will continue until the concentration of the fluids on either side of the membrane are equal, a mixed violet tone would result. But as this does not occur, he concludes that his results do not admit of a simple physical explanation. The author suggests two other explanations: either the methylen-blue cannot penetrate into the living cell because the outer cell layer opposes an insuperable barrier to its molecules (but this is not tenable, for living cells can be stained well by methylen-blue); or it is possible that

* Zeitschr. wiss. Mikrosk., xxii. (1905) p. 91.

both stains penetrate the cell, but that one undergoes changes according as the cell is alive or dead, so that only one stain is represented. The author gives as an example the central nucleus that stains blue in an otherwise only red-stained cell, and to the blue-stained bacteria contained in the nutrient vacuole of a red-stained amœba, and concludes that both the red and the blue stain are to be found in the stained object, and points out that the simultaneous presence of both stains in the cell would be demonstrated by the addition of hydrogen peroxide, a mixed violet stain resulting. The author concludes that with the use of his mixed stain, the methylen-blue is present in the living cell, and that the neutral red is present in the dead cell, but by the chemical influence of the protoplasm they are rendered invisible. And further, that the neutral red staining of the living cell is a chemical process, whilst the methylen-blue staining of a living cell is a vital phenomenon, but has a physical basis.

(5) Mounting, including Slides, Preservative Fluids, &c.

Method for Mounting Celloidin Sections.*—D. Cristina proposes the following method. The sections, being cut and stained, are transferred to alcohol at 94° for a short time; from this reagent they are taken by means of strips of blotting paper and transferred to specially prepared glass slides: these have been spread with glycerinated albumen (egg albumen 5 parts, neutral glycerin 1 part); the paper strip with the sections attached is laid, section side down, on the prepared surface of the slide, other dry strips being laid over it and gentle pressure made with the finger. The sections remain firmly fixed.

Method of Staining and Permanently Preserving Urinary Sediment.†—P. Fiorentini and M. Signer stain the deposit obtained by centrifuging or by sedimentation with the Ehrlich triacid mixture, and then treat the material with glycerin slightly acidulated. Treated in this way permanent and contrast-stained preparations of urinary deposit are easily obtained. The authors are vague as to time and acidity.

(6) Miscellaneous.

Keeping Polyzoa.‡—F. St. John Parker hit upon the idea of taking only a few small colonies and dividing these among several aquaria, thus allowing the groups ample room. He found this plan answered perfectly, and he writes :—"I can keep Polyzoa in captivity for very much longer periods than I found possible before adopting my present plan. Last September I found some specimens of *Fredericella sultana*, some of which were alive in March this year, when an accident unfortunately destroyed them. I have at present a number of small, but flourishing, colonies of both *Fredericella* and *Plumatella repens* in the small square glass tanks which can be bought at Beck's for about 8*s*. each. Small groups of about half-a-dozen or so individuals are all that are needed for the Microscope to make a really fine display, under dark-ground

* Zeitschr. wiss. Mikrosk., xxii. (1904) p. 99.
† Tom. cit., pp. 187–9 (1 pl.).
‡ English Mechanic, lxxxii. (1905) p. 187.

illumination. Another advantage of my plan is, the larger colonies are left behind in their natural habitats, and the danger of extermination is reduced to a minimum. My method, as detailed above, I have found equally successful for *Plumatella*, *Lophopus*, *Alcyonella*, *Fredericella*, *Cristatella*, etc. Of course, in the case of such voracious creatures, ample food must be supplied, and, from my own extended observations, I conclude that this is largely vegetable. Where practicable, I invariably keep the specimens supplied with water from the original habitat; but when that could not be done, I have found tap-water, with the addition of some clear river-water, to answer very well. Experiments with tap-water alone have not been so successful."

Metallography, etc.

Etching of High Carbon Steel.*—E. H. Saniter having failed to obtain good etching of high carbon steels, especially in the tempered condition, with iodine, 2 p.c. nitric acid or picric acid, tried Sauveur's method of dipping in strong nitric acid (sp. gr. 1·42) and washing at the tap. This gave better results, but several treatments were required to obtain the desired etching. He then tried dipping the specimen in absolute alcohol, followed by strong nitric acid and washing at the tap. This gave a good etching with only one treatment. The specimen should be held in a pair of forceps and moved about rapidly in the acid. Fresh acid must be used for each etching.

Metallography of Iron and Steel.†—R. A. Hadfield, in his Presidential Address to the Iron and Steel Institute, regrets the tendency to multiply the names of micro-constituents, and suggests the terms "martensitic structure," "sorbitic structure," as being less liable to misconstruction than the terms "martensite," "sorbite." The marked differences of opinion as to the meaning of the currently accepted designations of the constituents of steel should lead to caution in their use. The address deals with a very wide range of topics connected with the metallurgy of iron and steel.

Experiments relating to the Effect on Mechanical and other Properties of Iron and its Alloys produced by Liquid Air Temperatures.‡—R. A. Hadfield, after giving a résumé of previous investigations into the properties of metals at low temperatures, describes his methods of mechanically testing at the temperature of liquid air, and gives the results of mechanical and electrical tests, some 1600 in number, carried out on an extensive series of alloys. At $-182°$ C., commercially pure iron, which is highly ductile at the ordinary temperature, becomes brittle and has a much greater tensile strength. Great increase in tenacity and decrease in ductility also result when carbon steels (0·1 p.c. to 1·5 p.c. carbon) are cooled to $-182°$ C. Brinell hardness tests confirm these conclusions. Nickel on the contrary improves both in tenacity

* Iron and Steel Mag., x. (1905) p. 156.
† Journ. Iron and Steel Inst., lxvii. (1905) pp. 85–7.
‡ Tom. cit., pp. 147–219 (14 figs., 37 diagrams); Discussion, pp. 220–55.

and ductility when [illegible] of temperatures, and the effect of [illegible] the tendency of [illegible] at low temperatures. Microscopic examination of [illegible] specimens [illegible] did not [illegible] any indication of changes in micro-structure [illegible] at [illegible] low temperatures. An excellent feature of the paper is the comprehensive bibliography appended.

[illegible] paper [illegible] details of the [illegible] and [illegible] properties of Hadfield's [illegible]-manganese-[illegible] alloy [illegible] advanced [illegible] explaining the [illegible] differences in the effect of low temperatures on different [illegible] alloys. [illegible] Hadfield's [illegible]

The Types of Structure and the Critical Ranges on Heating and Cooling of High Speed Tool Steels under Varying Thermal Treatment.*—H. C. H. Carpenter has obtained cooling and heating curves of 24 specimens of steel containing one, two, or three of the alloy metals chromium, tungsten, and molybdenum in varying percentages. The carbon varied from [illegible] p.c. to [illegible] p.c. For [illegible]-chromium-carbon alloys [illegible] the initial temperature from which the [illegible] is cooled [illegible] influence on the position of the critical point, and [illegible] the critical point. He also concludes that, contrary to the widely accepted belief, the presence of [illegible] instead of [illegible] the transformation of hardening carbon [illegible] carbon during cooling. The action of tungsten and molybdenum in high-speed steels is to hinder or prevent the changes which result in a softening of the alloy, and so impart a high resistance to tempering. The steels examined, when cooled from temperatures not higher than [illegible] C., pass through a critical change at about 7[illegible]° C. If the initial temperature is raised, the same rate of cooling being maintained, the critical change is usually split into two or more parts and spread over a range of temperature from 7[illegible]° to 300° or 400° C., or even lower. Molybdenum is more active than tungsten in producing this split. When suitably treated, the alloys useful as high-speed steels have a polyhedral or "austenitic" structure.

Heat Treatment and Fatigue of Steel.†—F. Rogers has carried out a large number of mechanical tests (tensile and fatigue) on samples of three steels containing respectively 0·14 p.c., 0·27 p.c., and 0·52 p.c. carbon, heat treated in different ways. The alternating stress machine was of the Wöhler type, the fatigue tests carried out on it exhibited great irregularities. The author concludes that overheating lowers the elastic limit greatly, while increasing Young's modulus, these two effects both tending to reduce the resilience of the steel enormously. Steel fatigued beyond a certain limit cannot be restored by heat treatment alone. Microscopic examination of polished and strained specimens demonstrated that fatigue cracks tend to select a path through ferrite.

The Elastic Properties of Steel at High Temperatures.‡—B. Hopkinson and F. Rogers have found that with rise of temperature, up

* Journ. Iron and Steel Inst., lxvii. (1905) pp. 433–73 (14 pls.).
† Tom. cit., pp. 486–94.
‡ Proc. Roy. Soc., Ser. A, No. 76 (1905) pp. 419–25 (3 figs.).

to 800° C., the stress strain relations in steel undergo a change, the "time effect" or "creeping" becoming much greater. A test piece 4 in. long, about 0·2 in. diameter, with enlarged ends screwed into steel bars 1¼ in. diameter, was heated in a vertical electrical resistance tube furnace. Tension up to 1½ tons per square inch could be rapidly applied. At temperatures of 600°–800° C., the effect of applying the stress was to produce an immediate extension followed by a slow drawing out. On removal of load an immediate shortening occurred, followed by a slow contraction. Young's modulus was found to decrease considerably with rise of temperature.

Metallography Applied to Foundry Practice.*—A. Sauveur describes the microscopical outfit adapted for the examination of cast-iron specimens. Vertical illumination is more generally useful than oblique, which gives a negative image.

Special Steels.†—L. Guillet summarises the results of his well known investigations on alloy steels. He deals chiefly with ternary steels (containing iron, carbon, and a third element), some quaternary steels being also considered. The author is convinced that vanadium steel, containing less than 0·7 p.c. of that element, is likely to increase largely. Titanium steels and cobalt steels are devoid of any practical interest. While the micrographic character of pearlite steels furnishes only very partial indications of their mechanical properties, it may be at once concluded from the martensitic structure of a steel that it has a high tensile strength and elastic limit. A polyhedral steel has a low elastic limit, high elongation, great resistance to shock, and a hardness depending on the alloy element. Graphite steels are useless for practical purposes, the presence of this constituent causing fragility.

Induction Galvanometer for the Study of Freezing and Critical Points.‡—Dejean describes a modified Desprez-d'Arsonval galvanometer, in which the moving frame carries two distinct coils. One of these is connected to a thermo-electric couple inserted in the specimen under observation. Variations of temperature cause rotation of the two coils, thus inducing in the second coil a current which is measured by another sensitive galvanometer. The induced current is proportional to the velocity of rotation of the coils, and therefore depends upon the rate of heating or cooling of the specimen. A method of automatic recording is described, and critical point curves of a number of samples of steel are given.

The Crystallisation of Iron and Steel.§—In this introduction to the study of metallography, a course of six lectures by J. W. Mellor, the subject is dealt with in an elementary manner, controversial matter being touched upon very briefly. Starting with the general phenomena of crystallisation, allotropy, and entexia, the author considers the modes of solidification and subsequent cooling of solutions, taking particular instances of alloys as examples. The formation of the various constituents of iron-carbon alloys by the cooling, slow or rapid, of a homogeneous

* Iron and Steel Mag., x. (1905) pp. 309–13.
† Tom. cit., pp. 314-21 (3 figs.). ‡ Rev. Met., ii. (1905) pp. 701–4 (4 figs.).
§ London: Longmans, Green, and Co., 1905, x. and 144 pp., 65 figs.

liquid solution of carbon in iron, is clearly explained. The law of mass actions and the influence of passive resistance in opposing the change of an unstable condition to one of stability, are fully considered in their great effect upon the final constitution of steel subjected to thermal treatment. The author supplies a real want by a brief statement, intelligible to the student commencing the subject, of the phase doctrine as applied to the study of alloys. The influence of the crystalline structure of iron and steel upon their behaviour when subjected to stress is dealt with on the lines developed by Stead, Ewing, Rosenhain, and others. The slip band theory of the plastic deformation of steel is adopted. Possibly too much importance is attached to intracrystalline weakness in steel, the results obtained by recent workers tending to show that intracrystalline weakness is more serious, and that fracture, in structural iron and steel, usually proceeds through the crystals along cleavage planes. The chapter devoted to the preparation and examination of microscopical specimens gives the approved methods of polishing, etching, mounting, etc. A useful feature is the appended glossary, which closely follows that drawn up by a committee of the Iron and Steel Institute. Throughout the work the standpoint taken is that of the allotropists, though the subcarbide theory of Arnold is stated as an alternative explanation of the hardness of quenched steel. The book may be recommended as a lucid outline of the metallography of iron and steel as this somewhat complex subject stands at the present time.

BEILBY, E. T., & H. N.—**The Influence of Phase Changes on the Tenacity of Ductile Metals at the Ordinary Temperature and at the Boiling Point of Liquid Air.**
Proc. Roy. Soc., Ser. A, No. 76 (1905) pp. 462–8 (4 figs.).

DELVILLE, P.—**The Influence of Titanium on Pig Iron and Steel.**
[A résumé of the available information on the subject.]
Iron and Steel Mag. (1905) pp. 230–4.

DILLNER, GUNNAR, & EUSTRÖM, A. F.—**Magnetic and Electric Properties of Various Kinds of Sheet Steel and Steel Castings.**
Journ. Iron and Steel Inst., lxvii. (1905) pp. 474–80.

GARDNER, J. C.—**Effects caused by the Reversal of Stresses in Steel.**
Tom. cit., pp. 481–3.

HOUGHTON, S. A.—**Note on the Failure of an Iron Plate through "fatigue."**
Tom. cit. pp. 383–9 (2 figs.); Discussion, pp. 390–4.

LECARME, J.—**Cementation of Steel.**
[A reply to H. le Chatelier's criticism of the author's former paper on the subject—see J.R.M.S., 1905, p. 669. It is pointed out that much of the experimental proof of the author's statements was omitted from the article referred to, with the object of condensing it.]
Rev. Met., ii. (1905) pp. 720–1.

ROGERS, F.—**Troostite.**
[The author combats Boynton's view of troostite as β iron, and gives evidence to show that it contains carbon.]
Journ. Iron and Steel Inst., lxvii. (1905) pp. 484–6.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 18TH OF OCTOBER, 1905, AT 20 HANOVER SQUARE, W.
DR. D. H. SCOTT, F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 21st of June, 1905, were read and confirmed, and were signed by the President.

The List of Donations to the Library, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society were voted to the donors.

Bausch, E., Manipulation of the Microscope. 4th ed. (Rochester, N.Y., 1901	*The Publishers.*
Bausch, E., Use and Care of the Microscope. Extracts from Manipulation of the Microscope. (Rochester, N.Y., 1902)	*Do.*
Czapski, S., Grundzüge der Theorie der optischen Instrumente nach Abbe. 2nd ed. (8vo, Leipzig, 1904)	*Messrs. Carl Zeiss.*
Lee, A. B., The Microtomist's Vade Mecum. 6th ed. (8vo, London, 1905)	*The Author.*
Mellor, J. W., The Crystallisation of Iron and Steel. (8vo, London, 1905)	*The Publishers.*
Rohr, M. von, Der Bildezeugung in optischen Instrumenten. (8vo, Berlin, 1904)	*Messrs. Carl Zeiss.*
Records of the Egyptian Government School of Medicine. Vol. iii. (4to, Cairo, 1905)	*The Director of the Egyptian Govt. School of Medicine*
Scales, F., Elementary Microscopy. (8vo, London, 1905)	*The Publishers.*
Thirty-third Annual Report of the Local Government Board. Supplement containing the Report of the Medical Officer for 1903–4. (8vo, London, 1905)	*The Medical Officer of the Local Government Board.*
An Old Wilson Screw-Barrel Microscope	*Major Meade J.C. Dennis*

An old Wilson Screw-barrel Simple Microscope, date about 1750, and now presented to the Society by Major Meade J. C. Dennis, was exhibited, and a written description of the instrument by Mr. Parsons was read to the meeting by Dr. Hebb.

The thanks of the Society were voted to Major Dennis for this donation.

Mr. E. Moffat read a short paper describing a new and simple form of camera for use with the Microscope, illustrating his remarks by reference to a diagram. The arrangement referred to was also exhibited in the room.

The thanks of the meeting were voted to Mr. Moffat for his communication.

A form of Microtome devised and used by Mr. Flatters for cutting the very beautiful vegetable sections which were so well known to most Fellows of the Society, was exhibited by Dr. Hebb, who read a short paper descriptive of the chief points in its mechanism and the advantages claimed. The instrument was afterwards handed round for the inspection of those present.

The President said they were very glad to have had the opportunity of seeing this form of Microtome, which seemed a very good one for the purpose for which Mr. Flatters used it.

The thanks of the Society were voted to Mr. Flatters for his exhibit, and to Dr. Hebb for reading the description of it.

Mr. E. E. Hill, for Messrs. Beck, exhibited and described the Ashe-Finlayson Comparascope, an instrument which could be easily fitted to any ordinary Microscope for the purpose of comparing two objects, by showing both in the field of the Microscope at the same time.

The President said he believed they had the instrument before them in a rough form some time ago, when it was exhibited by Mr. Finlayson, and were now very glad to see it in its finished condition. It seemed likely to be extremely useful to microscopists, especially as it could be applied to any Microscope, and afforded a ready means of comparing objects directly under circumstances which rendered it possible to easily detect slight differences.

The thanks of the Society were voted to Mr. Hill for this exhibit and description.

A paper by Professor Henry G. Hanks, of San Francisco—a Corresponding Fellow of the Society—entitled, "Notes on Aragotite, a rare Californian Mineral," was read by the Secretary.

The President believed that this paper was one of great interest to mineralogists, and they were much indebted to the author for sending it to them. He noticed that some of the measurements were given in decimal parts of an inch, instead of in millimetres and microns, which had now become so generally adopted that it was rather to be regretted that the old measurement had been given in this instance.

The thanks of the Society were voted to the author of the paper, and to Dr. Hebb for reading it.

The President called the attention of the Fellows present to an exhibition on the table of a number of Slides from the Collection recently presented to the Society by Mr. W. M. Bale. A specially interesting feature of this exhibit was a collection of Orchid seeds, which were excellently mounted and gave a good idea of the extremely simple structure of these minute seeds. Those who had not already seen them would, he felt sure, be very pleased to look at them after the Meeting.

The following Instruments, Objects, etc., were exhibited:—

The Society:—An Old Wilson Screw-Barrel Microscope.

The following Slides from the Collection presented by Mr. W. M. Bale:—Seeds of the following Orchids: *Caladenia Patersoni*, *Calochilus Robertsoni*, *Diuris maculata*, *Pterostylis nutans*, *Thelymitra aristata*, *T. longifolia*; Spores and Elators of Scale Moss, Fossombronia?; Spores of Liverwort, Fimbriaria; ditto Targionia; Capillitium and Spores of Stemonitis (Myxomycetes); Capillitium and Spores of Trichia; Crystals from Wine; Gizzard of large Grey Grasshopper; Starch of Canna.

Mr. E. Moffat:—Portable Photomicrographic Camera.

Dr. Hebb:—The Flatters Microtome.

Messrs. R. & J. Beck:—The Ashe-Finlayson Comparascope.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Thomas Skelton Cole, Alfred Douglas Hardy, and John Perceval Lord.

MEETING

HELD ON THE 15TH OF NOVEMBER, 1905, AT 20 HANOVER SQUARE, W. G. C. KAROP, ESQ., M.R.C.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 18th of October, 1905, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society since the last Meeting (exclusive of exchanges and reprints) was read, and the thanks of the Meeting were voted to the donors.

	From
Flatters, A., Methods of Microscopical Research. (8vo, London and Manchester, 1905)	*The Publishers.*
Goeldi, E. A., Memorias do Meseu Goeldi. IV. Os Mosquitos no Pará. (Para, 1905)	*The Author.*
Index Catalogue of the Library of the Surgeon-General's Office, United States Army, 2nd Series, Vol. X. (8vo, Washington, 1905)	*The Surgeon General U.S. Army.*
Lucernal and Solar Microscopes by Adams	*Mr. Wynne E. Baxter*

The Old Microscope presented to the Society by Mr. W. E. Baxter was exhibited, and explained by Mr. Rousselet to be one described by Adams in his book published in 1787 as "Adams' Improved Lucernal Microscope," several examples of which, though differing somewhat in form, were already in the Society's Collection. The one before the Meeting was arranged for viewing both opaque and translucent objects. The Solar Microscope, also presented, was described in the same work as "Adams' Improved Solar Microscope," and was intended to be illuminated by sunlight reflected from a mirror through an opening in a shutter.

The Chairman said it was a little difficult to understand how they obtained sufficient light for an instrument of that kind, as the oxy-hydrogen light had not at that date come into use. And with regard

to the Solar Microscope, it was clear that the reflected ray would move in accordance with the apparent motion of the sun—did the observer have to come outside the shutter to put it into position when required, or had they any kind of heliostat?

Mr. Rousselet said there was a screw arrangement connected with the mirror by which it could be moved so as to follow the sun.

The thanks of the Society were voted to Mr. Baxter for his donation.

Dr. Hebb said they had received a small piece of apparatus called a Focusing Magnifier—sent by Taylor, Taylor, and Hobson, of Leicester, for exhibition and inspection at the Meeting—a photographic auxiliary which would no doubt be found useful to those who were interested in photography. A description of this was read to the Meeting.

Dr. Hebb also exhibited an elaborately constructed turntable, the invention of Mr. Flatters and Mr. William Bailey, which was driven by clockwork, and geared in such an ingenious manner that almost every kind of motion could be obtained by it. It would describe a circle, an ellipse, or even a square. The apparatus appeared to require considerable skill to use it, though no doubt anyone accustomed to the mechanism of a lathe would be able to do so without much difficulty.

A detailed description of the machine was read to the Meeting.

The Chairman remarked that the instrument was a very ingenious one, and it was interesting to have had the opportunity of seeing it, but it was doubtful if anyone present would have occasion to mount objects in such numbers as to need an apparatus of this elaborate construction.

The thanks of the Meeting were voted to Mr. Flatters for sending this very beautiful piece of mechanism for exhibition.

A Nernst Lamp, for use in enlarging photographs and also for use with the Microscope, was sent for exhibition by Mr. R. W. Paul, who was unfortunately unable to be present to give information as to its advantages.

Dr. Hebb said he had one of these in use in the Laboratory of Westminster Hospital which answered very well, though personally he did not like to use such a strong light, and had therefore handed it over to his laboratory attendant.

Mr. C. L. Curties said he exhibited a similar lamp at the Society's Meeting some time ago, and supplied the one to which Dr. Hebb had referred.

The Chairman regretted that they had no paper to be read that evening, but Mr. Watson Baker had arranged an exhibition of dissections of the Tsetse Fly, of Trypanosomes, and of a blood-sucking maggot, which would be found of great interest. They were much indebted to him for bringing them on that occasion.

The thanks of the Society were voted to Mr. Watson Baker.

Mr. F. W. Watson Baker said that in addition to the slides illustrating the Anatomy of the Tsetse Fly which were on exhibition there were two or three others of special interest. It seemed that amateurs found difficulty in obtaining specimens of the Tsetse Fly in this country, especially in a condition fit for preparation as Microscopic objects. They usually arrived either too dry or damaged. The specimens which were exhibited and which had been prepared from a large number of insects would, therefore, probably be of interest to the Fellows of the Society.

The slide showing Trypanosomes gave an opportunity of seeing the characteristic parasite of Sleeping Sickness, of which the Tsetse Flies are the medium of infection.

He also brought a specimen of the larva of *Ochromyia*, together with the perfect insect. The larva lives in the sandy earth, and attaches itself to the flesh and sucks the blood of the natives, causing very troublesome wounds.

There was also a specimen of the ova of *Schistosoma Sinense*, which he believed had not previously been shown at the Society. It was a recently discovered parasite found in the body of a Chinaman who died at Singapore.

The Chairman said that a very brief notice of this maggot (*Ochromyia luteola*) would be found in "Braun's Animal Parasites of Man," 3rd edition, 1903.

The following Instruments, Objects, etc., were exhibited:—

The Society:—Lucernal and Solar Microscopes by Adams.

Dr. Hebb:—Flatters' Clockwork Turntable for turning oval cells and rings; Taylor, Taylor and Hobson's Focusing Magnifier.

Mr. F. W. Watson Baker:—Dissections of Tsetse Fly, *Glossina palpalis*, Leg and Foot, Abdominal Membrane, ditto Spiracle, Mouth, Trachea, Antennæ, Halteres, Wing, Egg, Thoracic Spiracle; Trypanosomes; Blood-sucking Maggot and Fly (*Ochromyia luteola*); Ova of *Schistosoma Sinense* in Section of Liver.

Mr. R. W. Paul:—Nernst-Paul Lamp for use in conjunction with the Microscope.

New Fellows.—The following were elected *Ordinary* Fellows: Mr. Louis Charles Southall Broughton, Dr. F. M. Floyd, and Dr. Henry Gettys.

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